PUBLIC SCHOOL MANUALS

MANUAL TRAINING

PRINTED BY ORDER OF
THE LEGISLATIVE ASSEMBLY OF ONTARIO

cupboard & screen) [illegible]
designs from windowfold (numbered)
paper weaving
7 C fruits
7 C flowers
letters

4 letters [illegible] on both sides

WENDELL HOLMES
GOOD BOOKS AND STATIONERY
LONDON & ST. THOMAS

Nora Stainton
Leona Bent.
Section 11

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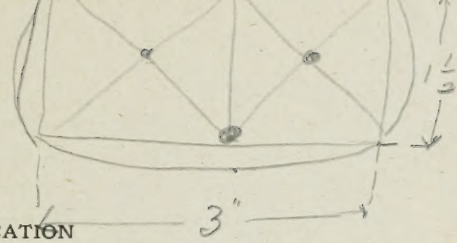

ONTARIO
DEPARTMENT OF EDUCATION

PUBLIC SCHOOL MANUALS

MANUAL TRAINING

REVISED EDITION

PRINTED BY ORDER OF
THE LEGISLATIVE ASSEMBLY OF ONTARIO

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NOTE

This manual is the property of the Board of School Trustees and is intended for the use of teachers only, and not of the pupils.

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(Name of Board of Trustees)

If a copy is desired by the teacher, it can be obtained at the Department of Education, Toronto, for 40 cents.

REVISED EDITION

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THE MINISTER OF EDUCATION FOR ONTARIO

PREFACE

This hand-book is primarily intended to assist in teaching the work in manual training outlined in the Course of Study for Forms I-IV, in those schools that are without special teachers and completely equipped manual training rooms. It should be remembered that the equipment suggested is not intended for those places that provide fully equipped centres; it is primarily intended for rural schools, where the accommodation is usually limited.

It will be noticed that the work for each Form is intended to cover two years of school life. Much more is included than can be usually accomplished in the limited time that is available at present; but this is done for the following reasons:

1. To offer a variety of choice both to teacher and to pupil. After a certain amount of preliminary training and practice, the pupil should be allowed to choose the object he is to make or to modify the design of the object assigned. Exercises that are chosen voluntarily are usually much better done than those that are prescribed.

2. To offer suggestions for home work. Home work should, of course, never be set in this subject; but experience has shown that the pupils are willing and anxious to do work of this kind for the school, the home, or the farm, outside school hours. Every encouragement should be given them to do this.

3. To allow a choice to be made according to the peculiar requirements of particular districts. The exercises given are not suitable to all schools alike; some are more suitable to rural than to urban schools; and even in the same city the requirements of different sections often vary.

It should be remembered that this Manual is issued solely as a guide to teachers. It is not a text-book, nor does its use render it unnecessary to consult the various reference books mentioned.

No teacher can successfully teach the work of his grade unless he knows thoroughly the work of the preceding grades. Before undertaking the work of any grade, the teacher should read carefully the chapters on "Materials and Equipment" and "Suggestions to Teachers".

Work in different materials should be taken concurrently. For instance, it is neither necessary nor advisable to complete the work in plasticine or clay before commencing that in paper. Many of the pupil's ideas will call for the use of all the materials in order that the fullest expression may be given.

It has not been considered necessary to state specifically at each stage the advantages to be gained from the introduction of this work. These are assumed, and the teacher who wishes to see them stated can consult the references given.

The previous edition of this Manual has been in use for six years; and the experience gained during that period has suggested many changes and additions. The chief of these changes are as follows: The instruction in mechanical drawing is now given in the third angle instead of the first angle, as the former is the general practice on this continent; courses are given in strip wood-work and coping-saw work that can be carried on in the ordinary class-room without elaborate equipment; a section is added on "seat" or "busy" work, which is an important factor in rural school organization; and notes on timber and tools are given, together with a series of models suitable for rural districts.

Prices have in all cases been omitted, as it has not been found possible to obtain quotations that could be guaranteed for any length of time. These should be obtained from the supply houses before the goods are ordered.

INTRODUCTION

The old idea that education was entirely a matter of books has now almost disappeared; and a system which appealed almost entirely to the memory is being supplemented by methods which directly appeal to the interests of the pupil and which use his own activity and observation in the training process.

These methods have received recognition in the Kindergarten and in the Kindergarten-Primary, and, if the work is useful there, it should be continued throughout the whole school.

It can hardly be questioned that the use of concrete material has a real and practical value in the training of the mental faculties. The pupil's conceptions of design, form, space, proportion, and extent, are broadened and made real and tangible.

In dealing with *things* the pupil learns to know and appreciate the "perfect thing". He soon arrives, under judicious and intelligent leading, at the stage when he will reject his own work if it be not up to his ideal. The formation of this ideal is in the hands of the teacher.

When a pupil reaches this stage, some progress has been made in that process of character building which should be an aim of all true educational effort. He learns a fact of which many workmen seem ignorant, that one inch means one inch and not a sixteenth over or under; and a habit of accuracy is inculcated which will permeate all his work whether in or out of school. Patience, concentration, application, and initiative are cultivated; and these are all very desirable elements in the character of a boy or a girl.

Manual Training must not be thought of in terms of processes only; it not only gives practice in doing, making, and originating; but, if properly undertaken, it is capable of being made to assist in the mental, manual, and social development of the pupil. In order to accomplish this desirable result, it must train and lead the pupil to think out processes intelligently and help him to see and to feel the relationships which this work bears to his other school work. Many school exercises not usually considered in connection with manual training may be made use of in this connection. The arithmetical exercise, the spelling paper, the composition paper, may be made models of simple beauty, orderly arrangement, and proper preparation. The work chosen must give the pupil technical skill and develop creative power; it must direct his attention to, and arouse his interest in, the construction done in the world around him.

The main object of this work is mental development and physical control. The making of things is not the primary object, and this should be made entirely secondary to the ideas and thoughts involved in the making. The exercises chosen and suggested by both teacher and pupil should be such as will arouse and maintain interest and take advantage of the pupil's desire to construct. Self-activity is one of the most essential of educational processes, and in the practice of the manual arts it may be made of great service.

Manual Training should make the ability to do a part of the knowing process and should combine theory with practice. The amount of work accomplished is unimportant in comparison with the mastery of correct methods and the formation of good habits.

Every opportunity should be given to the pupils to modify given type models or to design new ones and to rearrange given units or create new combinations. All the work should have in it the elements of beauty of construction, harmony of proportion, and appropriateness of decoration. Elaborate curves, outlandish designs, and glaring colours should be avoided. Though we may not be able to add to the quantity or the variety of material, we can modify its form, and we can arrange it in new combinations. The making of new forms and combinations and the giving of definite expression to ideas and mental images is the great Froebelian doctrine of creativeness.

One of the most important aspects of this work is that known as correlation. Elementary Manual Training should be regarded less as a subject than as a method of approach to other subjects in the curriculum. This should be emphasized wherever possible. Reading, writing, arithmetic, geography, history, nature study, drawing, and science can all be used in this connection. Lessons so chosen not only give manual dexterity, physical control, and ability to do, but also serve to make the instruction more real.

It cannot be too strongly insisted upon that every manual training lesson should be related either to some other phase of school work or to the vital interests of the pupil in the home, the playground, or the industrial life around him.

The subject, to be truly developmental, must not be regarded as an extra subject. It should be looked upon as an agent. The teacher who so regards it will find in it ample opportunities for supplementing in a practical way the ordinary work of the class. In drawing, arithmetic, geography, history, literature, nature study, and recreation, the teacher will find much in hand-work that can be used advantageously. When used co-ordinately with other subjects, it serves to correlate them, and so aids in promoting the unity of the Course of Study.

In the first year of school life, the conversations and readings naturally revolve around interests identified with the pupil's experiences at home. These home doings may be made a centre of broad possibilities for constructive work. The various things used in the daily round of home occupations are so familiar to the little child that he talks of them readily, is interested in picturing them, and makes them with pleasure. Thanksgiving, Christmas, and other holidays, afford excellent material for reading and story-telling, and to these centres the work in construction may be related easily.

Later, as the pupil's world grows larger, street doings and happenings enter into his life. When these are read and talked about in the class-room, many forms are mentioned which may be made with advantage. Still later, when the class work revolves around the study of peoples, or myths or tales such as Hiawatha or Robinson Crusoe, opportunity is offered for constructive work in weaving, braiding, cutting, binding, knotting, building, modelling, etc.

The advantage of making this correlation as close as possible may be summarized as follows:

1. The plan contemplates the use of constructive work as a means of expression and not as a form of technical drill.

2. It utilizes exercises in construction arising out of needs and experiences in the general curriculum.

3. It emphasizes the work of the individual as against that produced by dictation.

4. It aims to cultivate independence in execution and versatility in the use of many materials.

5. It aims to establish no "course" in paper, clay, cardboard, or raffia, etc., but welcomes the use of all available materials.

6. It presents itself as a means of illustrating and giving concreteness to the subjects of the general curriculum and as a means of developing the pupil through the response to his interest and to his desire to shape and mould things with his hands.

7. It aims to relate the pupil to the world about him. It searches the curriculum for objects which will do this, and, once it has found them, it employs whatever material is available and whatever processes are necessary.

MANUAL TRAINING

PUBLIC SCHOOL COURSE OF STUDY

(DETAILS)

FORM I

I. *Modelling*:

1. Free modelling. Pupils should be encouraged to express freely their own ideas in plasticine, clay, or sand; to illustrate stories; and to invent forms and patterns for themselves.

2. Representation of objects, as oranges, apples, nuts, vegetables, pet animals, loaf of bread, dishes, etc.

II. *Paper Cutting, Tearing, and Folding*:

1. Cutting out pictures from newspapers, catalogues, etc.; free cutting of objects in which the child is interested; for example, leaves, flowers, fruits, pet animals, vehicles, toys, tools, etc. The subjects chosen for free cutting may be connected with special days or seasons; for example, lily, rabbit, chicken, for Easter; trees for Arbor Day; stockings, bells, Santa Claus, for Christmas.

2. Assembling and mounting of objects cut, in groups to illustrate scenes, imaginary stories, or stories from the Primer and the First Book.

3. Folding simple geometric forms, such as square, rectangle, triangle, and the use of these as elements in the formation of patterns and designs.

4. Paper cutting and folding to make objects based on the above forms; for example, books, screens, windows, boxes, chairs, beds, carts, houses, sleds, baskets, tents, wall pockets.

III. *Weaving*:

1. Mat weaving in paper.

2. Weaving on simple loom with such materials as raffia, wool, yarn, string, pieces of clean rags.

3. The making of objects from coarse canvas; for example, needle-cases and book covers, using various stitches to form patterns for decoration.

FORM II

I. *Clay Modelling*:

1. Free expression work as in Form I, making special use of geography, history, and nature study; for example, land and water formations, scenes in connection with early discoveries and pioneers, animals and insects, fruits, common objects.

2. Modelling from memory, using well-known objects, as bottle, small bowl, birds' nests, animals, hats, etc.

II. *Paper Cutting and Folding*:

1. Paper cutting and mounting—the work of Form I continued—illustrating games, occupations, seasons and days, common land and water forms, historical facts.

2. Geometrical forms used as units in building up patterns and borders.

3. Advanced work in paper folding, including the construction of geometric figures, units for design, and objects more complex than those attempted in Form I—such as snow-flakes, stars, crosses, wall pockets, boxes, baskets, windmill, simple furniture.

III. *Cardboard Modelling*:

1. Simple exercises in light-weight cardboard similar to those already made in paper, distances obtained previously by folding being now obtained by measurement.

2. Geometrical construction of the square, rectangle, and circle, and the making of trays, boxes, baskets, wall pockets, and other objects based on these forms. At this stage simple appropriate designs may be used in the decoration of the objects made.

3. Mounting pictures, giving attention to suitable arrangement and harmony of colour between the picture and the mat.

FORM III

I. *Clay Modelling*:

1. Modelling of natural objects requiring greater detail.
2. Simple pottery.
3. Relief maps in clay or other plastic material.

II. *Paper*:

Illustrating by free cutting, as in Form II, special days and seasons, games, historical and geographical concepts, decorations, borders, scrap-books; the work to be more advanced.

III. *Cardboard Modelling*:

Geometrical construction of the triangle, hexagon, and octagon, and the making of objects based on them.

IV. *Mechanical Drawing*:

1. Use of ruler, set-squares or triangles, compasses.
2. Simple geometrical problems applied to cardboard construction.
3. Construction of, and working to scales of ½, ¼, ⅛.
4. Simple plans and elevations lettered and dimensioned; for example, plans of school-rooms, tool sheds, school gardens, etc.

V. *Work in Thin Wood*:

1. One-piece models; for example, plant label, key rack, pencil sharpener, geometric forms, clay-modelling tools, printing blocks.

2. Two-or more-piece models; for example, windmill, weather-vane, boat, bracket, plant ladder, boxes, toys, gates, fences, and work with strips.

FORM IV

I. *Clay Modelling*:

Modelling of a more difficult character than in Form III may be continued—relief maps, pottery, modelling from nature and from memory.

II. *Cardboard Work*:

Bound and covered exercises, mats in geometrical shapes, pen-and-ink trays, stationery boxes, napkin-rings, jewel boxes, objects based on the cube, cylinder, cone, and pyramid.

III. *Bookbinding*:

1. Loose-leaf books for pictures, photographs, or newspaper cuttings.
2. Simple repairs to damaged books, mending torn pages, re-inserting loose leaves.
3. Portfolios.
4. Sewing on strings or tapes.

IV. *Mechanical Drawing*:

The work of Form III continued, and extended to include simple geometrical problems required in preparing working drawings; practical methods of drawing the ellipse and the ellipse in a rectangle.

V. *Wood-work*:

The knife work of the previous grade continued and extended, with much greater stress on the mechanical drawing.

Simple objects or elementary apparatus required in the school, playground, or home discussed—shape, size, materials obtainable and methods of construction considered, drawings made, and the pupils encouraged to make the articles at home; construction of cupboards from packing cases, tool racks, and simple school and household repairs. Where properly equipped rooms are not available, much good and useful work can be done if one or two benches are supplied. Every school should have at least one bench with a set of tools. Where space is limited, this may be built along one wall in the school-room or placed in a dry, well-lighted basement. A shed on the school grounds may sometimes be utilized.

MATERIALS AND EQUIPMENT

PLASTICINE AND CLAY

Plasticine, which is an antiseptic material, can be obtained from any dealer in school supplies. It is sold in one-pound cartons. Plasticine, being of a greasy nature, should never be used on any absorbent material such as paper or unvarnished wood. It retains its plastic condition for a long time; but if it should become a little too hard to work easily, it can be softened as follows:

Press or roll out into thin, flat sheets, smear with a *little* vaseline, roll up, and work with the hands until it is soft to the touch.

Plasticine may be obtained in the following colours: gray, green, brick-red, yellow, blue, and white. One pound will provide sufficient material for four pupils.

Clay may be obtained either in powdered form known as clay flour; in five-pound cartons or bricks; from most potteries and brickyards ready for use; and from natural clay beds.

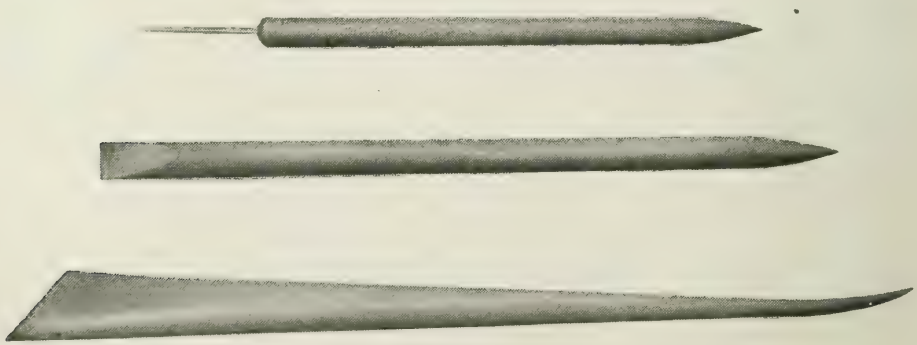
EQUIPMENT REQUIRED

Modelling should not be done directly on the desk. Any grease-proof surface may be used to model on, such as school slates, sheets of heavy brown paper, or pieces of table oil-cloth.

Modelling boards, about 12 in. x 12 in., of pine or basswood varnished, with ends secured by cleats to prevent warping, may be purchased if desired.

Very few modelling tools are required. The fewer used the better. When special shapes are needed, the pupils can generally whittle them from small pieces of wood.

The accompanying illustration shows good general tools which may be purchased cheaply.



A small piece of No. 3 rattan or a common match stick is often of great service. A wooden mallet in the form of an ordinary potato masher, a wooden spatula, small sponges, and dusters are also required.

If no wash bowl is convenient, a small pail to contain water will be necessary.

STORING CLAY

The following may be used, each being provided with a cover to prevent evaporation:

A zinc-lined wooden box with two divisions, an earthenware vessel, or an enamelled vessel.

A bread or biscuit tin is also useful for storing small quantities.

In more advanced work, where it is necessary to keep uncompleted objects from lesson to lesson, they must be covered with a damp cloth. Biscuit tins make good receptacles for small models, but a zinc-lined cupboard is the best.

MIXING CLAY FLOUR

Clay flour may be mixed with water and kneaded like ordinary dough. When the mixture ceases to be sticky, it is in good condition. For large quantities it is best to begin the mixing at least a full week before the material is required.

1. To mix twenty-five pounds of clay, put about three or four quarts of water into the clay box, and into this sprinkle and stir the clay flour until the mixture becomes too stiff for further stirring.

2. Leave the box lid open, to allow the superfluous water to evaporate.

3. Each day take a large wooden spatula and work the clay in the box, leaving the surface as uneven as possible to encourage evaporation.

Clay so prepared is kept in good working condition by covering with a damp cloth. Where feasible, each pupil should prepare a small quantity of clay for himself.

TO PREPARE CLAY FROM A NATURAL CLAY BED

Good clay is found in some localities, but it is almost sure to contain grit or other impurities. To remove these, mix the clay thoroughly with water until it is reduced to the consistency of cream. The heavy matter, stones, etc., will settle quickly to the bottom. Pour the remainder through a piece of coarse sacking, allow it to settle, pour off the water, and spread out the sediment to dry. This sediment may be treated in the manner recommended for bringing clay flour to a proper consistency. More washings and finer sieves will produce finer clay.

In some districts it may be possible to obtain clay fairly free from grit and other impurities. In such cases it may not be absolutely necessary to follow the above method, but all clay taken directly from the natural bed is improved by such treatment.

TO KEEP CLAY IN GOOD CONDITION

At the end of the lesson, all waste clay should be returned to the division of the box specially provided for it and be pounded with a mallet. A damp cloth should then be spread over it, and the lid closed.

To bring dry, hard clay back to a plastic condition, it should be broken into fairly small pieces and packed as closely as possible in one division of the clay box or in an ordinary pail or crock. Sufficient water should then be poured in to barely cover the clay. Allow it to soak for a day or two, stirring occasionally. This will produce a soft clay which can be brought to a proper consistency by the method described in mixing clay flour.

MODELLING MIXTURES FOR PERMANENT OBJECTS SUCH AS RELIEF MAPS

1. Salt and Flour:

Enough flour to bind the salt is all that is necessary. A simple combination is about half of each mixed with water to the consistency of putty or stiff dough. This gives a beautiful, clean, modelling material which dries white and takes colour well.

2. Sawdust and Flour:

About equal proportions mixed with water give another material very suitable for relief maps. This makes a mixture much harder than the wood from which the sawdust was obtained. The colour will depend upon the sawdust used, and the texture upon its fineness or coarseness.

3. Paper Pulp:

This may be made from old newspapers torn into very small pieces. Pour boiling water over them and let them stand for forty-eight hours. Pour off the surplus water and stir vigorously with a stick. The paper pulp thus formed can be used to greater advantage than that obtained at paper mills, as the gray colour is more pleasing than the white of the commercial pulp.

HINTS ON WORKING CLAY

The clay should be handled as little as possible, as, owing to the heat of the hands, it soon loses its plasticity and breaks and crumbles when an attempt is made to press it into the desired shape. Clay in that condition is useless and should be returned to the box.

The greater portion of the modelling should be done with thumb and fingers. The thumb is more sensitive than the fingers and is the most important tool used.

Flat shells, leaf forms, or similar thin objects which are built up in the solid on a slab, often require undercutting to give the effect of thinness. This effect can be secured by cutting away a portion of the backing or supporting clay, so that, when viewed from the position in which it was modelled, no backing clay would be seen, but only the edge of the leaf or shell.

Clay work should be built up by adding small pieces. The purpose is to work the clay forming the model to an even consistency; for clay shrinks considerably during drying. If this is not attended to, the model will shrink unevenly and so be out of shape when dry.

ARMATURES

If the clay is to be fired, no other substance must be used in building up the models, as, owing to the unequal contraction of different substances, the models would break whilst in the oven. If the models are to be cast in plaster or to be allowed to dry naturally, it is often an advantage, and sometimes a necessity, to build the model round a framework or skeleton, in order to give greater solidity to the whole and particularly to the slender parts. For instance, if one were modelling a small human figure with outstretched arm, it would be necessary to model that arm round a piece of wire or wood, which would in its turn require to be fastened to some support within the body of the model. The handles of vases, cups, etc., are also better strengthened in this way. Such internal supports are called armatures.

SAND TABLE

This is a most necessary piece of equipment in any school, but is especially necessary in a rural school. It can be purchased from any dealer in school supplies. It is generally 6 feet long, 30 inches wide, and 24 inches high.

Tables or trays, of a cheaper kind, may be made as follows:

1. By putting a rim about 1 inch thick and 2 or 3 inches deep round the top of an ordinary kitchen table, and shortening its legs. The tray would be improved if lined with zinc.

2. By putting a rim (as above) on a board of the desired size. A good lid or the side of a packing-case will serve. Line the board with zinc if possible. It can be used over a couple of desks or on ordinary trestles and stored away when not in use.

3. A large bread pan or tray may be used for smaller work. If these are used, one may be provided for each pupil.

4. A wooden box of the required depth may be lined with oil-cloth and filled with sand.

5. In summer a load of sand in a corner of the playground may be used to advantage.

TO WASH SAND

Put the sand in a pail or tub, pour on plenty of water, and stir. The clay, humus, and other impurities can be poured off when the sand settles. Continue this until the water is clear. Where available, run a gentle stream of water from a hose into the tub and keep its contents well stirred. Continue until the overflow runs clear.

Washed sand may be purchased from dealers in builders' supplies.

PAPER WORK

Engine-coloured Paper:

4 in. x 4 in. in packets of 100 sheets,
5 in. x 5 in. in packets of 100 sheets,
Large sheets 22 in. x 28 in.,
Other sizes cut to order.

These packets may be obtained in (*a*) assorted colours, (*b*) tints of standard colours, (*c*) standard colours, (*d*) shades of standard colours, (*e*) neutrals and grays.

Tinted Drawing, Construction, and Mounting Paper:

This is a heavy paper made in 20 colours.
6 in. x 9 in., one colour, in packets of 100 sheets,
9 in. x 12 in., one colour, in packets of 100 sheets,
12 in. x 18 in., one colour, in packets of 100 sheets,
Single sheets, 24 in. x 36 in.

Heavy Folding Paper:

6 in. x 6 in. cover paper, six colours, assorted in packets of 100 sheets,
7 in. x 7 in. medium weight cover paper, six colours, assorted in packets of 100 sheets.

Cover papers of various weights and qualities may be obtained in large sheets.

Dull brown or gray wrapping-paper for mounts and construction work varies in price according to size, weight, and quality.

The above sizes and descriptions are those used by dealers in school supplies, from whom material and sample books of the various colours may be obtained.

PASTES

1. Put one tablespoonful of powdered alum into one quart of water and bring to a boil.

2. Cream one cup of flour (equal to one-half pint) with a little cold water in a two-quart granite pan.

3. Pour the boiling alum water on the cream and cook for twenty minutes, stirring constantly to prevent lumping.

4. Add twenty drops of oil of cloves, strain out any lumps, and pour into a glass or stone jar.

This makes about three pints. It will not freeze nor harden. If too thick for the purpose, thin a little with water. Make exactly as directed.

Another paste may be made by adding a tablespoonful of gum tragacanth to a pint of cold water. After standing for ten or twelve hours, this will be of the consistency of jelly. Stir in a few drops of oil of cloves, and it is ready for use.

To make a strong, flexible paste suitable for cardboard and bookbinders' cloth, add liquid glue to ordinary flour paste in the proportion of one-third glue to two-thirds paste.

Paste may be purchased in the powdered form and in small pots.

OTHER MATERIALS USED IN CONNECTION WITH PAPER AND CARDBOARD

Toothpicks; pea sticks; paper fasteners; tying materials, such as coloured string, wool, raffia, twine, ribbon, etc. Ingrain wall-paper is often useful for making long mounts or for other cuttings. Sample books of wall-paper which may be obtained from paper-hangers or manufacturers will also be found useful.

Rules and scissors will also be required.

CARDBOARD CONSTRUCTION

Tinted Bristol-board, 22 in. x 28 in. in packets of 100 sheets,

Pulp boards, size 20 in. x 30 in. The thicker the board, the fewer sheets in the bundle.

Mill-boards are sold in similar bundles. These are intended for cutting boards, and should be ordered cut to the required size.

Bookbinders' cloth up to 3 ft. in width may be purchased in rolls of varying length.

Ticket punches,

Cardboard knives,

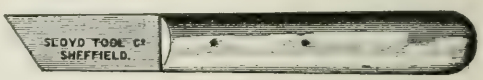
Scissors, 6 in.,

Leather punches,

Set-squares,

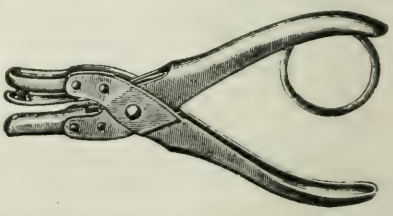
Eyelets (No. 18) in boxes of 1,000,

Shoemakers' eyelet punch No. 10,



A good pencil compass and an ordinary H drawing pencil,

Flat rulers graduated in 1 in., ½ in., ¼ in., and ⅛ in. A brass strip let into the lower edge is advisable, to protect the rule from injury when cutting or scoring.

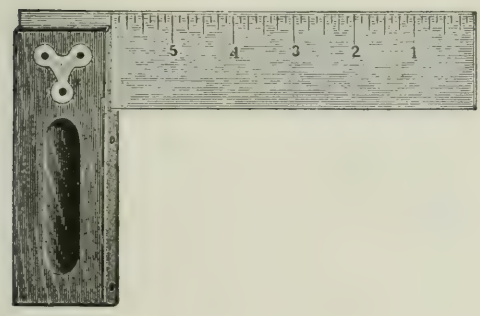


Other fastening materials, such as raffia, wool, string, and paper fasteners.

General class box or cupboard for storing the materials when not in use.

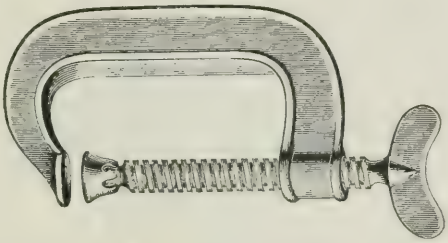
THIN WOOD

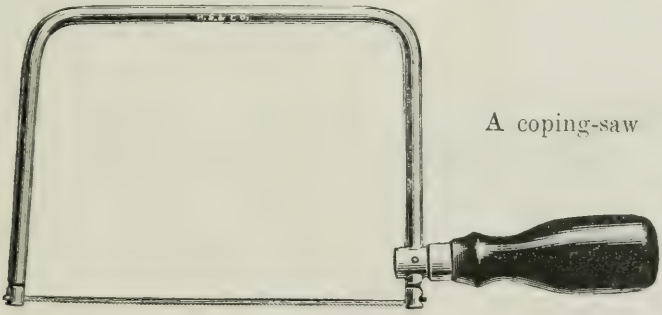
A knife. In case satisfactory knives are not available, the pupils might be allowed to use their own pocket knives.



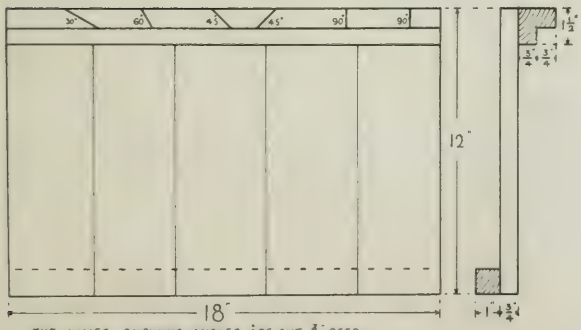
A ruler of good quality
A 6-inch or 4-inch try-square
A small hammer

A small clamp for holding the cutting board to the desk or the work to the cutting board when necessary



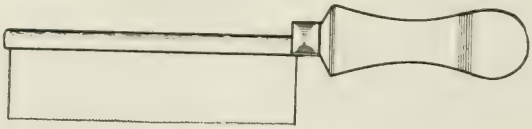


A coping-saw



THE LINES SHOWING ANGLES ARE CUT ¾" DEEP
THE 12"-18" BASE IS BEST MADE FROM SEVERAL PIECES

Cutting Board: 12 in. by 18 in., which is large enough to protect the desk from saw cuts, nails, scratches, etc. The ends of the strips may be sawn at angles of 60°, 45°, 30°, or 90°, by using the angle cuts in the back block as guides.



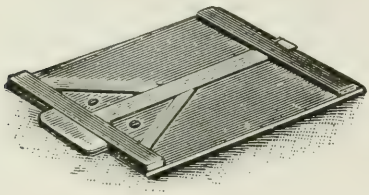
Small Back-saws: 6-in. blade. These have been specially made for the Ottawa Public Schools by Shurley Dietrich & Co., Galt.

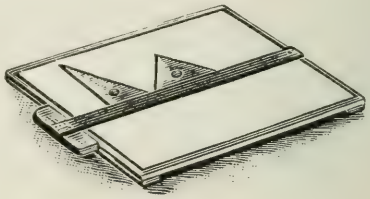
Nails: ½ in. and ⅜ in. No. 20 flat-head

Glue: One can of liquid glue

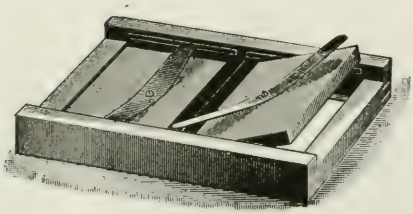
Sand-paper Blocks: Sand-paper, if used without a block, wears away very rapidly and is not so effective. These blocks, which can be made by the pupils, consist of sand-paper glued on to stiff cardboard. A sheet of sand-paper (about No. 1 or 1½) will cut into nine pieces of suitable size.

Drawing Kit: This consists of a drawing-board with tee square and two set squares. When not in use these are attached to the back of the board.





THE PRINTING-FRAME



A frame must be provided similar to that used in photographic printing and large enough to hold the drawing flat against the glass.

As a substitute for the regular printing-frame, a good wooden picture-frame may be used, provided some means are employed to ensure that the copy and the blue-print paper are well pressed against the glass and that arrangements are made to examine the print without disturbing it.

Another simple printing-frame may be made by taking two pieces of glass, dividing one of these into two, and hinging these two together by means of passe-partout binding strips or bookbinders' cloth. After the blue-print paper and drawing are in position, these two sheets of glass can be held in place by means of two elastic bands.

The drawing, which takes the place of the negative in photographic work, must be inked in on good tracing-paper or cloth, and all lines not wanted in the blue print should be omitted.

In place of a drawing on tracing-paper or cloth, leaves, grasses, flowers, weeds, etc., may be used. These give very satisfactory and interesting prints.

Sun Printed Leaf (Sweet Birch)

Place the drawing or leaf, etc., with the lines against the glass; place over it the blue-print paper, sensitized (yellow) side down; fix the back of the frame so that the drawing and the blue-print paper are firmly pressed against the glass; expose to direct sunlight if possible. Continue the exposure until the blue-print paper assumes a reddish lavender colour. Three or four trials will show the exact depth of printing required with the particular brand of paper used. This signifies that the action of the light is complete. Wash the print thoroughly, preferably under running water, and hang it up to dry.

Great care must be exercised, when examining the print, not to disturb its position.

RAFFIA AND OTHER MATERIALS

Raffia is the outer cuticle of the leaves of the Raphia Ruffia palm, which is stripped just as the leaves are about to open. It grows in Madagascar and is largely used by the natives for making hats, mats, ropes, bags, screens, etc. It is a tough, fibrous material and can be used either alone—as in mats, woven or knotted bags, soft coiled baskets, hats, cushions, braids, or in combination with other materials, as with cardboard, for foundations for serviette rings, mats, boxes, pin-cushions, etc., or with rattan, for Indian baskets and rings.

Natural raffia or coloured raffia may be used. Wool, soft cord, carpet ravellings (washed) strips of clean rags, yarn, dried grasses, etc., may often be used with advantage in weaving various articles.

DYEING

Raffia of the required colour may be purchased, or the natural raffia may be dyed. As raffia is a vegetable substance, it requires a cotton dye. Packet dyes may be used if the directions are followed closely. It is, however, an interesting occupation for the pupils to gather the materials for the dyes. The beautiful colour effects of Indian baskets were all obtained from vegetable dyes, the materials for which were collected by the Indian women. The best time to gather these materials is in October or November, when the seeds and fruits are ripe, and the sap is well down in the trunks of the trees.

One teacher had her scholars gather walnut shucks for dyeing purposes, and they secured a very pretty shade of green. Three or four weeks later they again

needed some green dye and gathered more walnut shucks. This time their green dye came out "brown". In addition to obtaining the dye, a valuable lesson in nature study was provided. The green colouring matter had gone, new or changed matter was in its place.

The faded flowers of the purple iris are full of purple liquid, and, when they are rubbed on raffia or rattan, colour it a beautiful shade which is quite as fast as most dyes.

St. John's Wort—the stems, leaves, and flowers—which can be found growing on the roadside, gives a pleasing light yellow.

Cranberries give a dull red, and beets a colour similar but more satisfactory. The poke-berry gives a purple red. The powder of blood-root gives a deep yellow. Golden-rod blossoms make a very effective dull yellow.

Butternut bark gives a fine brown. Walnut and hickory-nut shells can also be used with good results. The bark of the maple and pine both give good shades of brown; and pleasure may be found in experimenting with bark from different trees.

Logwood extract, fustic, saffron, and all the vegetable extracts may be purchased from the druggist if desired.

As a rule all materials and dyes need a mordant. This is to "fix" the dye. Alum is a good ordinary mordant. One authority recommends the use of a solution of three ounces of alum dissolved in a quart of water. Another prefers much less—about four ounces to two gallons of water. When the alum is well dissolved, place the liquid in a small tub and soak the material to be dyed for fully two hours. This allows the fibres of the raffia or rattan to take up the mordant and thus prepares for the permanent fixing of the dye.

For a dye-pot a good enamel kettle is quite serviceable. All materials should be boiled. Two ounces of material to one gallon of water generally gives a fairly strong dye. It can be diluted if necessary, and if found not strong enough can either be boiled down or more material used.

In using beets put in about five or six large beets to a gallon of water. If these do not produce the desired colour, put in more. For cranberries use about one pound to a gallon of water.

For butternut bark, walnut shucks, sumach, poke-berries, onion skins, etc., use all that can be held in both hands; a little more will do no harm.

All of the above will generally give their colour by boiling rapidly for half-an-hour.

Before dyeing, the material should be placed in the mordant as before described. The dye should be strained, in order to prevent irregular colour effects. The dye should be boiling when the material is immersed, and then be kept just at the boiling point for the time required (generally from fifteen to twenty minutes). Experience will show that gradations of colour can be secured by keeping the raffia a longer or shorter time in the bath. Boiling or keeping at too great a degree of heat will burn or rot the raffia. Keep turning the material over and over, so that it may be dyed evenly. A wooden stick may be used for this purpose. To prevent mildew and rotting, be sure that the raffia is thoroughly dried before using.

THE HECTOGRAPH

The hectograph is a device for making copies of written work. All teachers will find it of great service, particularly those whose schools have limited blackboard space. Drawings, recipes, and other rules for work may be copied and distributed to the pupils and thus kept in a permanent form. Many other uses in connection with the general work of the school will suggest themselves.

Materials:

Three ounces of white pulverized glue,
Six ounces of rain water,
Twelve ounces of glycerine.

Directions:

Soak the glue in cold water for twenty-four hours. Melt, and let it boil hard for five minutes, stirring all the time so that it will not burn, put in the glycerine after it comes to a boil, and let it boil hard for ten minutes. Pour out into a pan set on a perfectly level surface. Break any bubbles with a toothpick or match. Let it stand twenty-four hours before using.

Dimensions of pan:

A pan ten inches by twelve inches and three quarters of an inch deep is of suitable size and can be made at any tinsmith's. A cover should be made to fit the pan.

Method of using:

Make the first copy on glazed paper with hectograph ink, using a stub pen. Lay the copy side down on the hectograph and press evenly all over. After about two minutes, remove the copy and apply the paper on which the transfer is to be made, observing the same caution as with the first copy. When the desired number of copies has been obtained, wipe the gelatine surface with a soft cloth dipped in lukewarm water.

NOTE.—If it is impossible to secure a hectograph, carbon paper may be substituted when duplications are required, especially of maps, pictures for colouring, etc.

SEAT WORK FOR RURAL SCHOOLS

One of the most difficult problems which the rural school teacher must face each day is the question of how she may provide the right kind of "seat" or "busy" work for the pupils during the time they must work with little or no supervision. She is often responsible for eight grades, and is thus able to give only one eighth of the day's time to the direct supervision of any one grade, and even this time has to be divided among all the subjects of the curriculum. In addition to this difficulty, her school board often fails to supply her with the necessary material. This latter condition is, however, being remedied rapidly, now that fairly substantial grants are being given by the Department of Education in order to assist in the purchase of equipment and supplies.

Rural school teachers, however, should not look upon these difficulties entirely as misfortunes, but partly as opportunities to develop ingenuity and resource and as a means of growth. They must realize that, during the seven eighths of the day when the work of the pupils of the rural schools must of necessity be more or less unsupervised, the process of habit formation is going on just as surely as during the one eighth of the day spent in the formal instruction, and that its strength is multiplied by seven. Habits of right or wrong methods of study or work, attention or inattention, mental alertness or laziness, are being formed proportionately to the care that is exercised in providing for seat work. The work assigned, particularly in the primary grades, must be designed for something more than to keep pupils quiet and out of the way.

The following suggestions may prove of service:

1. The work assigned must be educative—

It should have definite aims, such as to gain new facts, to test the assimilation of those already taught, to give opportunity for self expression of original ideas, to provide for growth in motor control, or to develop imagination. It must provide for advancement and not for marking time.

2. It must be interesting to the pupil—

We all work with greater vigour when we are interested, we do little that is of permanent value when interest is absent. If the work can be given in the form of a problem, an unanswered question, the work will be more intelligent, and the interest in it will be much greater than it would be if the pupil were asked merely to repeat exercises that he had done before. The same kind of assignment day after day tends to become very monotonous and uninteresting, though in itself it may be desirable, and, used occasionally, most valuable. In securing this interest, the age and environment of the pupil must also be taken into account.

3. It must stimulate alertness—

If the pupil is asked to do a piece of work more than once, he should be given some definite reason for doing so. Unthinking repetition tends to lessen mental activity rather than to increase it. To require the pupil to give the same attention to known as to unknown parts is training him to spend his time in a meaningless manner.

4. It must cultivate power of application and independent work—

This application will come with a definite, well-stated interesting problem; and independent thinking will be done when the work set calls for individual judg-

ment and selection of materials. The child must be kept mentally active. The young pupil should be allowed as much physical movement as possible. When he must remain in his seat, plan for all the activity which that position will allow. Work at the sand table is particularly good in this connection.

5. The work must provide for both the quick and the slow pupil—

The slow pupil should be made to feel that he is accomplishing something; and the work should be such that it leads the quick pupil to proceed to something else; that is, it should be such as to employ the energies of every pupil adequately, and not to allow any idle time.

Various suggestions for seat work correlating different subjects of the curriculum are given below:

NUMBERS

STRINGING:

All children seem to take special interest in this, and a great variety of problems may be given, such as, put two red beads and then two blue ones on your string, or for every third one a button mould or a straw, according to the material used. In this way the pupil is not only satisfying his desire for activity, but is building up number concepts and laying the foundations for addition combinations and the multiplication table.

Materials:

1. Peas or corn (white or red) softened in water,
2. Straws an inch long. To prevent these from splitting, pour boiling water over them, and, when cool, dry on a towel,
3. Salt beads,
   - Heat one-half cup of salt,
   - Mix one-quarter cup of starch with one-quarter cup of water and colouring material,
   - Mix this with the hot salt,
   - Mould, and put pin through, to make the hole,
4. Wooden button moulds, which can be purchased cheaply at any dry-goods store,
5. Large coloured wooden beads, which may be purchased from any school-supply firm,
6. Cranberries and pop-corn for the Christmas tree.

COUNTING EXERCISES

Materials:

1. Toothpicks and shoe-pegs coloured differently,
2. Seeds of the water-melon, squash, or pumpkin,
3. Sticks of varying lengths,
4. Rose-hips, acorns, and spools,
5. Squares of cardboard,
6. Figures cut from large calendar pads.

The ingenuity of the teacher will suggest a great variety of exercises which may be worked with the material suggested—soldiers marching in groups of twos, threes, fours, etc., grouping sticks according to length, colour, etc., group sticks or squares in consecutive piles, one in first, two in second, etc., and place correct number from calendar pad opposite each pile.

MISCELLANEOUS

1. Let the pupils make dominoes and later use them to play with.

2. Let each pupil construct from cardboard the face of a clock, attaching the hands. This may be used for exercises in telling the time. Give each pupil several circles and have them place the numbers in Roman letters like the model clock, and draw hands on one face to say nine o'clock, one to say ten o'clock, one to say half-past ten o'clock, etc., from directions on the black-board.

3. Make cardboard money, using real money for a pattern, or purchase a box of cardboard money from a school-supply firm.

4. Make packages supposed to contain various groceries, to be used in a play grocery store in which the pupils buy and sell and make change, using the paper money.

5. To illustrate fractions, let the pupils work with circles and squares cut in thirds, quarters, etc.

6. Fold paper into sixteen squares or oblongs. Colour designs for oil-cloth on one side. Make numbers, Roman numerals, words, etc., on the other side.

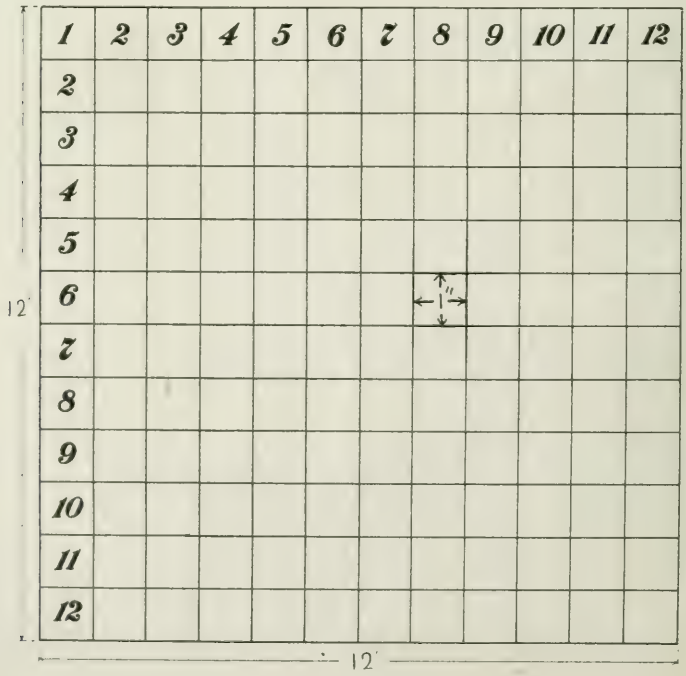
7. Third and fourth grades make paper mats; measure accurately with ruler. First and second grades colour and weave.

8. Third and fourth grades accurately construct triangles, squares, oblongs, etc., from stiff paper, to be used for design, number work, etc., in the first and second grades.

9. Making a multiplication game which is very valuable for drill purposes.

The directions for this are as follows:

(*a*) Divide a square of cardboard 12 inches by 12 inches into one-inch squares by fairly heavy lines. Number the squares along the top and left-hand side from one to twelve.



(*b*) Divide a nine-inch square of cardboard into three-quarter-inch squares. Place in these squares the products for all the multiplication tables from one to twelve. Cut into squares and place the squares in an envelope.

The game is to place these smaller squares into the proper square on the larger cardboard. The element of competition can be introduced, if desired, by letting the pupil who finishes first write his or her name on the black-board.

10. Paste numbers cut from calendar pads on to cards, for drill in quick column addition.

READING AND LANGUAGE STUDY

The Chapter on "The Pupil's First Day in School" offers many suggestions for valuable seat work. Stick laying, colouring mats, the formation of letters with sticks, straws, clay, or plasticine, the cutting of tops, hats, trees, flowers, and animals from paper may all be used satisfactorily in this connection. In most of this work the pupils may be left safely to their own devices.

NATURE STUDY AND AGRICULTURE

Booklets of various kinds may be made from drawing paper, or better, from bogus paper. Bright-coloured fall leaves, flowers, and weeds may be collected, pressed, mounted, and named. Blue-prints may be made and placed in the books. Leaves may be traced, coloured, and cut out and used for a black-board border or other school decoration. Outlines of the common moths or butterflies may be hectographed for the pupils to colour. Land and water forms may be modelled in clay, plasticine, or one of the modelling mixtures suggested on page 14. The sand table is also of great service in this connection.

GEOGRAPHY

Outline maps may be made on drawing paper with the hectograph or carbon paper, or one outline pattern of a map may be made on cardboard and cut out. This may be used to trace around, making as many outline maps as needed. One pattern lasts for a long time. These maps may be properly coloured to show various features, such as rainfall, wheat areas, corn areas, mineral resources, large cities, rivers, lakes, railway and steamship lines, etc. The maps should not be crowded. Each should contain one or two different features only. Maps from old geographies or atlases may be pasted on cardboard and cut into various forms. It is an interesting and useful occupation for the pupils to fit these together. Making scrap-books may also be of service. Pictures may be obtained from old magazines, the holiday publications of the great railway and steamship companies, and many other sources.

FORM I

THE PUPIL'S FIRST DAY IN SCHOOL

The pupil's first day in school is a critical period in his history. He comes from the freedom of the home or the organized play of the kindergarten, and the teacher should strive to make the change as imperceptible as possible. The previous activities of the home and the occupations of the kindergarten must be vitally connected with the more formal instruction of the school.

It has been said that "when the child goes into the school-room he has to put out of his mind a large number of the ideas, interests, and activities that predominate in his home and neighbourhood". It is the business of the teacher to make use of these interests and activities, not with the mere desire of making the work entertaining and pleasant, but because these interests and activities offer a point of contact and afford the only sure and satisfactory foundation for the work which is to follow.

A sound teaching maxim is, "in introducing new experiences to the child make use of some old or previous experience as a foundation for the new". What are the child's previous experiences? They are connected with playing, talking, eating, and sleeping, principally, and it is one of these that we can first make use of in this connection. Most children have been accustomed to tearing and cutting paper into small pieces in an apparently aimless manner. We do not know what is in the child's mind when he is doing this, but we can make profitable use of this experience.

The teacher should have on hand a number of coloured pictures similar to those on the covers of magazines and contained in certain monthly journals—pictures representing life and action. One of these should be given to each pupil. Show one already cut out and explain that you wish each pupil to look carefully at his picture to notice the outline of the figures or objects, and then to cut around that outline. This exercise develops manual skill, judgment, and carefulness. The pupil has to judge where and how he shall cut. If he is careless he will make a wrong cut and spoil his picture.

After a time the teacher may return to the class and have each pupil tell the story of his picture, thus making it into a language or an oral composition lesson. If there are several figures or objects in the picture, the pupils may learn to count them, and so get an introduction to number work.

Then show them how to paste and mount the pictures on paper of suitable size and colour. This occupation may be made use of with advantage throughout the first two years of the pupil's school life.

Use should be made of all available material, such as sticks, twigs, splints, straws, rushes, shoe-pegs, blocks, cubes, discs, beads, pictures, catalogues, clay, plasticine, sand table, coloured paper, crayons, pieces of cardboard, cardboard boxes, toys, cord, string, spools, pins, paper fasteners, wooden collar buttons (for cardboard construction), skewers, (number work, axles, handles), raffia, corks, canvas, needles, thread, scissors, doll's house, old packing cases, etc.

All these objects may be readily collected by the resourceful teacher. The sticks may be purchased or made by some of the older pupils or by the teacher.

Blocks should be cut the length of the sticks required (an exact number of inches) from a straight-grained piece of white cedar. These should be split into uniform size, and each pupil should be given a certain number of sticks which he may keep in a box in his desk. The educational value and interest of the work is increased if sticks of several lengths are used. Splints, such as are used by the Indians in basket-making, may be made from the black ash.

Other natural objects which have been found of service are, corn-cobs, which can be used for building barns, houses, fences, etc.; if they are cut and split into small pieces, figures of animals, men, etc., can be made by using toothpicks for legs. Corn-stalks cut into varying lengths make excellent building material. Pins may be used for joining. Cat-tail reeds may be used in the same way. Corn-husks combined with raffia make effective baskets or mats.

The discs may be cut from old cardboard boxes by the use of a common wad-cutter such as is used in cutting wads for a gun (No. 10 or 12), or by a three-quarter-inch leather punch. These discs may be best cut by using the cutter on the end of a block of green wood, as this is less likely to turn the edge of the cutter. Tops for milk bottles may be purchased cheaply and may be used as wheels for wagons, tops for small tables, or strung together for counters.

The pupil's formal introduction to school life should be through the use of concrete material and objects. Many pages of the Ontario Primer suggest preliminary work of this character with the various materials mentioned. At first the teacher may suggest "what" but leave the "how" to the pupils. Later they will be ready and eager to suggest for themselves. At this stage the teacher should not be too much in evidence.

It cannot be too strongly insisted upon that here the imagination of the pupil must be allowed the freest play. The results may appear crude to the teacher, but they mean something very real to the pupil and must be judged, at first particularly, from his standpoint. Free expression work suggested by the lessons in the Primer forms an excellent occupation for little children while the teacher is engaged with other classes.

The work should be made as topical as possible. Young children always look forward with great anticipation toward times, seasons, and festivals. These can all be illustrated. For example:

Hallowe'en	Cut and colour pumpkins.
Thanksgiving	Lanterns, pumpkins, fruits, vegetables, turkey.
Autumn	Cut leaves and colour them with crayons.

Christmas decorations for the tree, such as—

(*a*) Paper chains—coloured paper: green, red, silver, gold,

(*b*) Bells of heavy red paper,

(*c*) Santa Claus cut from heavy red paper, attaching string for hanging,

(*d*) Stars—cardboard covered with silver or gold paper,

(*e*) Pine-cones, walnuts, and butternuts—gild and drive in small tacks to which attach strings for hanging,

(*f*) Snowballs—balls of cotton dipped in white of egg and sprinkled with diamond dust.

(*g*) Icicles made from strips of gold or silver paper about three quarters of an inch wide and rolled like the old-fashioned lamplighters or "spills".

(*h*) Lanterns—Use manilla, gold, or silver paper six inches by nine inches. Fold lengthwise to crease. Cut folded paper in strips one quarter of an inch wide to within half an inch of the top edge. Join the edges at the side with paste and attach the handle. If manilla paper is used, the handle and top edge may be painted black and the rest brightly tinted.

January Calendars, snow-flakes, sled, toboggan, skates, snow man, Eskimo,
February Valentines, winter sports.

Plate 1.—Paper cutting and mounting illustrations for Easter

March Windmills.

April (Easter) Chickens, rabbits, lamb, lily, snowdrop, crocus, tulip, daffodil, hepatica leaf, umbrella, skipping, playing marbles,

May Baskets, gardens, sprouting acorns and chestnuts. Plant peas and beans, etc., in window boxes and model them at different stages of their growth. Empire Day, Arbor Day.

June Birds' nests and eggs, growing plants, fruits, summer sports, camping.

Plate 2.—Paper cuttings illustrating St. Valentine's Day

Plate 3.—Paper cuttings illustrating Hallowe'en

Plate 4.—Paper cuttings illustrating Christmas

MODELLING IN PLASTICINE

The best modelling material to use in the lower forms is plasticine. It may be obtained ready for use and remains in workable condition longer than clay.

For a preliminary lesson give each pupil about one fourth of a roll of plasticine to "play with". This will give experience in handling, and the pupil will soon begin to "make things". In this way he will discover how to make balls and flat discs, how to roll out long pieces, how easy it is to break off and to attach a piece wherever required. At a later period, this self-discovered information will be made use of in giving expression to ideas received from various sources.

The following is the method adopted by a successful teacher in using this material:

FIRST STEP:

Choose a simple story having well-defined action; for example, "Jack and Jill", "Tom, Tom, the Piper's Son", "Little Boy Blue". Tell the story simply and briefly with strong emphasis on the action. Have a few of the pupils "act" the story. Let the pupils then model any part of the story that appeals to them. The expression is to be entirely spontaneous and uninfluenced by any direction concerning methods of procedure. The pupils should be encouraged to talk about their models and to explain the significance of the various parts.

SECOND STEP:

Tell a story and let the pupils select a particular scene. Question definitely, until they have formed a clear mental picture. Direct the questions, so that the pupils will observe comparative sizes, forms, characteristic features, and appearance in given positions, either in rest or action.

The pupils then work without further direction. A language lesson should follow, in which some of the pupils are given an opportunity to explain their models to the remainder of the class. Pupils should be encouraged to point out the good features in the work of their fellows.

THIRD STEP:

Give the pupils the plasticine, with the simple direction: "Make anything you wish, and, when you have finished, you may tell me the story".

The above method deals entirely with the free expression of the pupil's idea. It will, of course, be necessary, in order to secure definite results, to give definite instruction in the use and manipulation of the material.

Beads are amongst the easiest of the early manipulations of any plastic material, and an early lesson on their making is desirable.

A LESSON ON BEAD MAKING

Materials:

Modelling boards, plasticine, blunt needles, or round toothpicks.

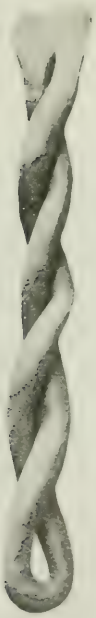
Show a string of beads and induce the pupils to tell how to make a similar string. How much plasticine is required to make a certain size of bead? About the size of the end of the teacher's finger or some familiar object. Each pupil

nips off a piece about that size. How shall we make this round? By rolling. Some have been made too flat. Why? When the small beads have been made, compare them with real beads. What more is required? A hole through the centre. How is this made? Question as to stringing.

If string is used, it should be of good firm quality. A piece of No. 3 rattan would be better. At this early stage the beads may be joined by small pieces of plasticine. At a later period, a string of graded beads might be made or one each of the beads and discs alternately. Small beads of different coloured plasticine may be pressed out flat and used to make many familiar things; for example, cakes, biscuits, dishes, buttons, etc. These may be used to form different number combinations, border designs, etc.

ROLLING PLASTICINE

Another method of using plasticine in the Primary Forms is to form rolls of it, from which, in conjunction with the previous work, many objects can be made, such as letters, ropes, nails, hammers, anchors, chairs, rugs, bottles, bangles, candles, spectacles, dumb-bells, whips.



HOLLOWING

Make a small ball, press it flat, then place it in the left hand and press it into the required shape with the thumb or finger of the right hand. With the addition of this simple manipulation to those already learned, many other objects can be made, such as mushrooms, saucers, basins, cups, flower-pots, ink-wells, salt shakers, puddings in basins, sugar scoops, sauce-pans.

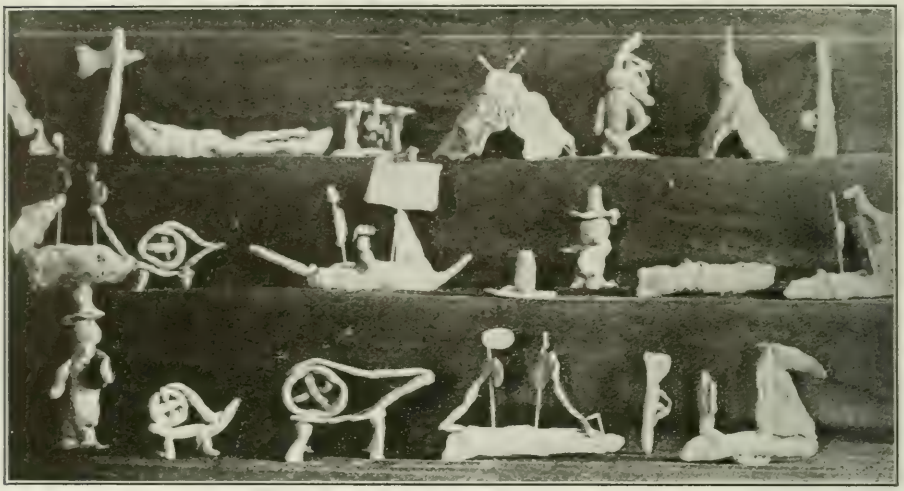


Plate 5.—Plasticine modelling, illustrating stories of Indian life and of the Pilgrim Fathers

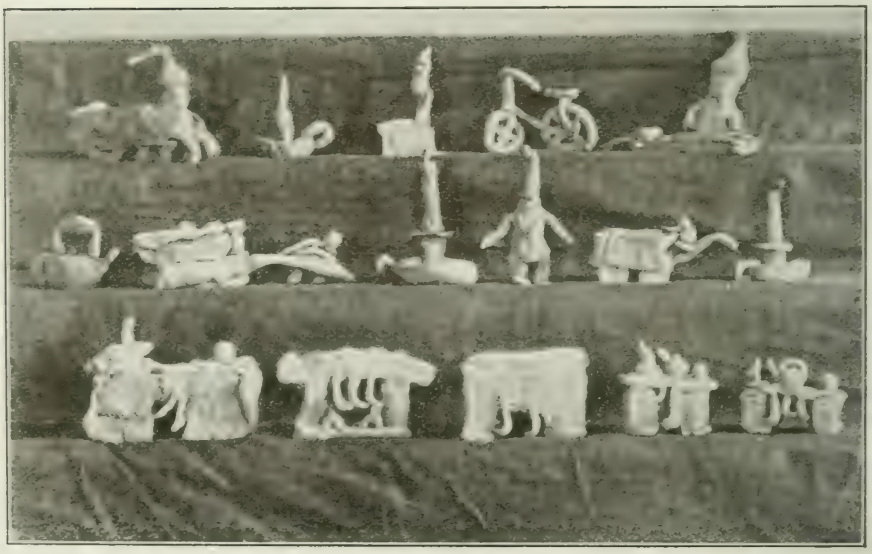


Plate 6.—Plasticine modelling, illustrating the Christmas season

OBJECTS FROM THE BALL

Objects formed from the ball, such as cherries, plums, apples, nuts, acorns, onions, pears, oranges, lemons, can be made at this stage. Wherever possible, have the real object in front of the pupils. Failing the actual object, good pictures or sketches are serviceable. Animal forms, such as snails, fishes, cats, dogs, rabbits, ducks, swans, mice, form good subjects.

DESIGNS

Another useful exercise to which plasticine lends itself is the formation of various border, centre, and corner designs made up of geometric units, such as squares, circles, triangles, and other forms. The three following plates show to a small extent what can be accomplished in this direction. The number of possible combinations is practically unlimited.

DRAWING ON PLASTICINE

Plasticine may also be used to great advantage for simple drawing. Roll or press it out to form a thin slab. Ordinary school slates make excellent frames on which to roll out the material, as the sides serve to determine the depth of the plasticine and to facilitate the formation of a good flat surface. Use a blunt point as a tool for making the necessary lines, dots, or other markings. Plate 9 shows a variety of patterns made in this way. The surface can be smoothed out when any alteration is required.

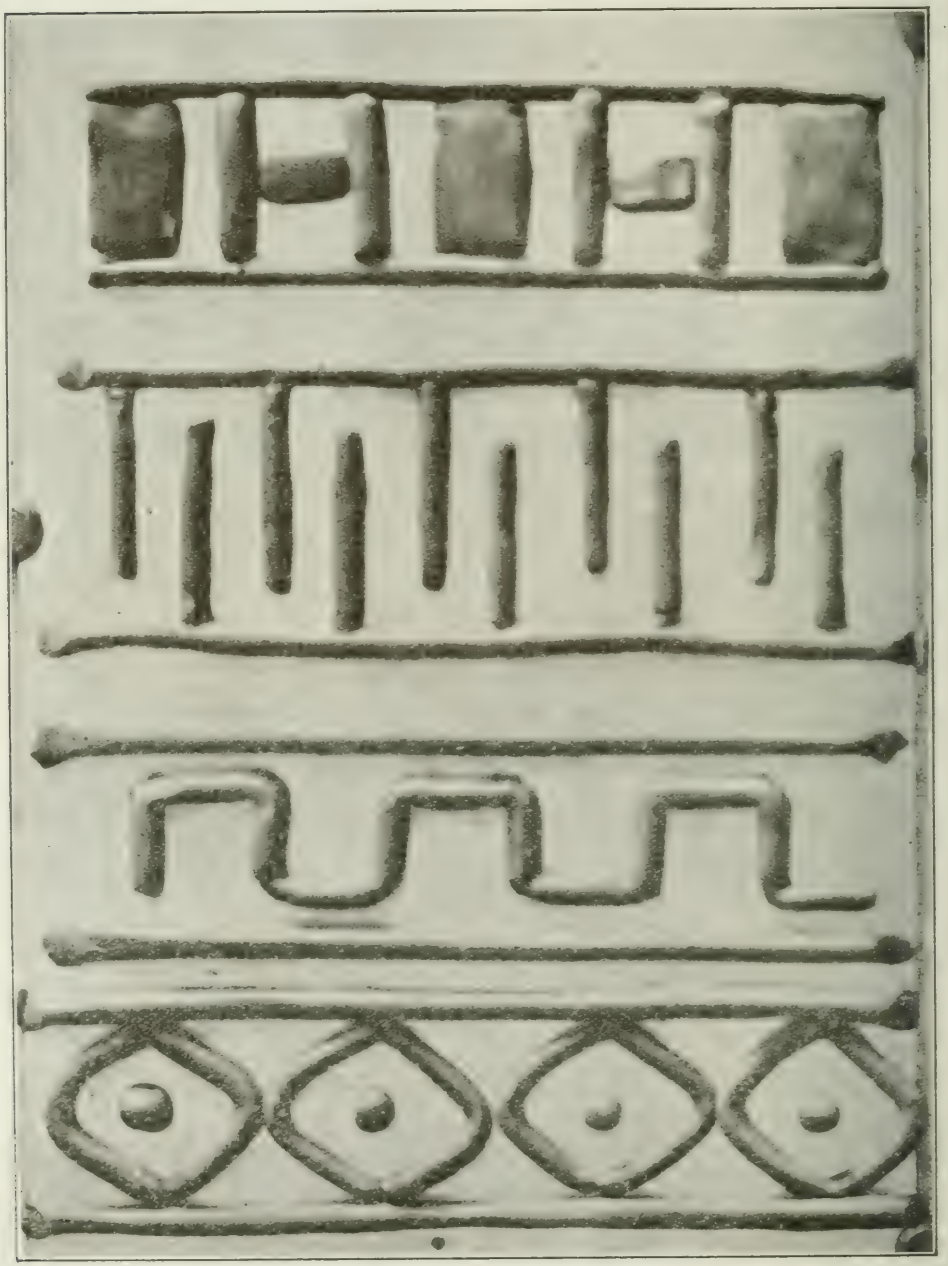


Plate. 7.—Border designs in Plasticine

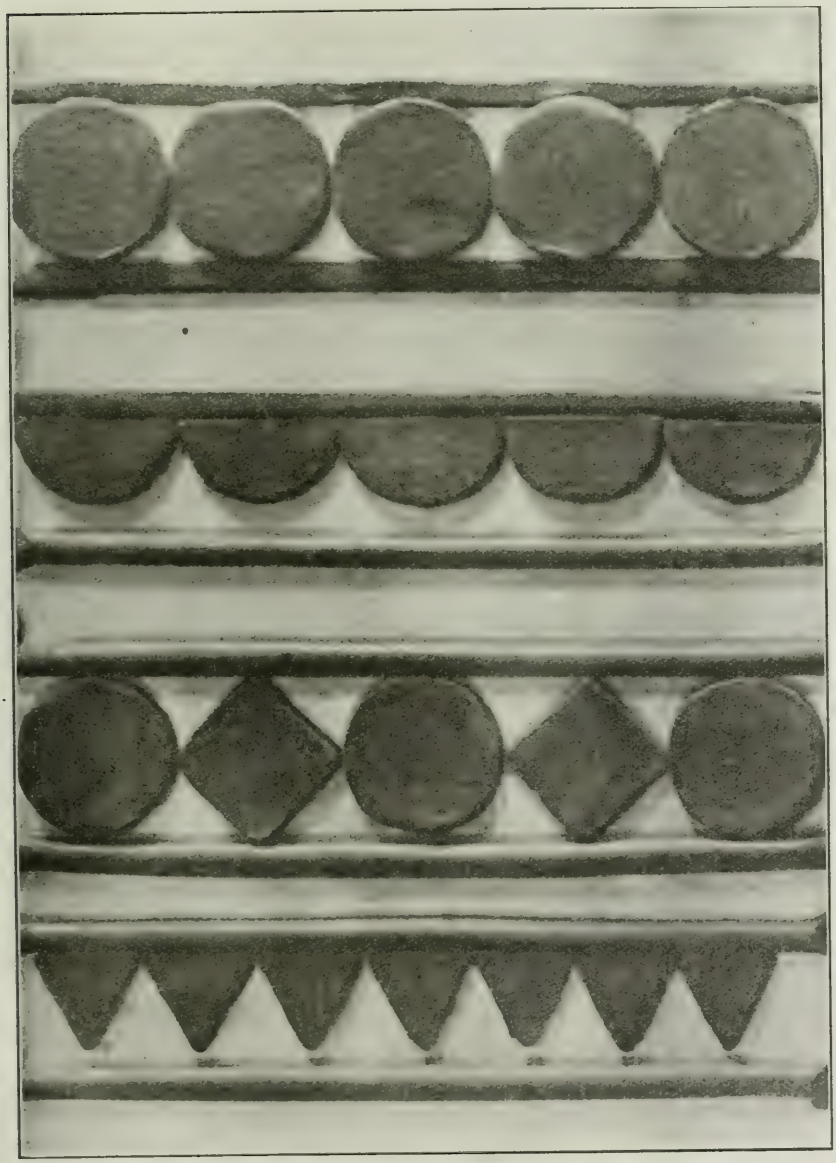


Plate 8.—Border designs composed of shapes cut from Plasticine

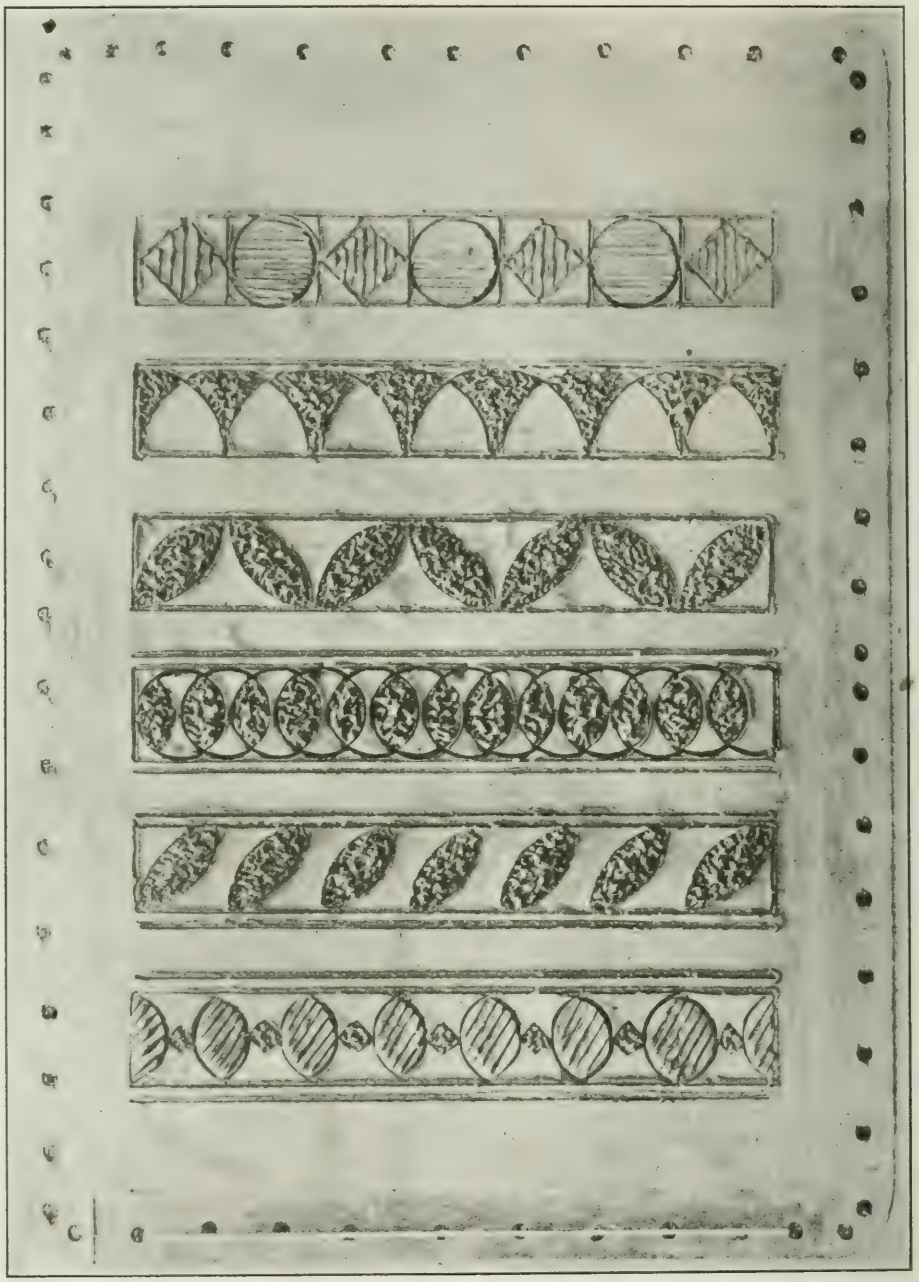


Plate 9.—Border patterns drawn on a slate filled in with Plasticine

MODELLING IN CLAY

Success in modelling in clay depends largely upon the right consistency of the material. The pages of the Primer and the First Reader are full of suggestions as to suitable objects for modelling. These should be made use of as soon after the reading lesson as possible, while the ideas are fresh in the minds of the pupils.

The suggestions offered for modelling in plasticine may be largely followed in clay work, and vice versa. Suitable subjects, some of which the pupil will generally adopt when suggested by the teacher are:

Activities of the Home: Washing day, baking day, cleaning day, visiting, going to church, shopping;

The Farm: Animals, implements, troughs, barns, sheds, fruits, vegetables;

Foods: Milk, milkmaid's stool and pail, cows, butter making, cheese making;

Transportation: Wagons, buggies, street cars, railway coaches, boats, ships, sleighs;

Water Supply: Wells, barrels, pumps, skin-bottles, ancient water-carriers, yokes, and pails;

Shelter: Wigwams, snow houses, sand huts, log cabins;

Various Industries: For example, the carpenter—his saws, hammers, chisels, saw-horses, planes, nails, tool chests;

Games: Marbles, skipping, base-ball, football, cricket, etc.

Indians: Tepees, canoes, baskets, ornamental head-dresses, peace pipes, bows and arrows, and other articles illustrating Indian life in peace and war.

In modelling various fruit and animal forms, the pupils will require specific instruction with reference to the representation of certain features of the object. At this stage, only objects of a fairly solid nature should be attempted. As examples of this specific instruction, take the following:

Apple: Take a piece of clay. Make a ball free from crevices and a little smaller than the apple to be modelled. Notice the various lobes of the apple, and gradually add small pieces of clay well worked in until the desired shape is obtained. Next, by means of the finger and thumb, make, as far as possible, the recess in which the stalk grew. The deeper portion of this recess may be made with a piece of rattan. Hold the rattan between the thumb and finger and push it into the centre of the recess. Roll the rattan by sliding the thumb and finger one against the other, and at the same time give the whole hand a circular motion. Now take the opposite end of the apple. Make the recess there with the end and side of the thumb. Make a ball about the size of a very small pea and press it into the centre of the depression. With the rattan make a hole in the centre of this flattened ball, leaving only a ring formed by its edge. Roughen this with the point of the rattan, imitating the original as closely as possible. Insert a small roll of clay for the stem.

ILLUSTRATIVE LESSON

Every pupil has an apple, brought from home or supplied by the school. The apple is placed on the desk in front of each pupil.

Let us make a ball somewhat smaller than the apple. How can we do this? By rolling between the palms of the hands.

What else have we made in this way? Marbles. Make one. What is the difference between the marble and the apple? The apple is larger, but the marble is rounder and smoother. The apple has a little hole in the top and another at the bottom. What grew in these holes?

Are your apples all alike? Examine your apple. What do you notice? It has little hills or ridges. How can we make these ridges? By working in small pieces of clay. Do this until your apple is the right shape. Why did we make our ball a little smaller than the apple? So that we could add the little pieces and not have it too big.

Look at your apple again. What else do we want? The hole at the bottom. How can we make this? With the finger and thumb. Do this. Now look at the hole in the apple and the hole in your model. What is the difference? The hole in the apple is deeper. How can you make the hole in the clay apple deeper? By using a short piece of round stick. Let the pupils try this, and correct if necessary.

Now take the other end and make the hole. Look at this hole in the apple. In the centre of this there is a little round piece sticking up. How can we make this? By pressing into our model a little round piece of clay. How large? As large as a small pea. Press this in and make it as much like the real apple as you can. (The teacher examines the work, and, where necessary, offers suggestions.)

Tell me any other things that can be made from a ball. Oranges, lemons, pears, plums, eggs, turnips, radishes, tomatoes, onions, grapes, cherries, strawberries, etc. Make some of these during your seat-work period.

Pear: Make a ball. Squeeze one side to the shape of the pear to be modelled. Finish as in the apple.

Orange: Form the general shape as above. To obtain the texture, take a small piece of round rattan or stick, cut the end square across, and with this make the little depressions by tapping; or twist a small piece of clay into the form of a thin stick, break off a bit leaving the end slightly rough, and tap as with the rattan. A lemon may be modelled in the same way.

Acorn: Get the general shape from a small ball. The point may be obtained by pressure between the finger and thumb. Put the finger and thumb together, and, in the angle formed by their tips, place the tapering end of the model. Now press the finger and thumb together, and, by turning the model slightly after each pressure, the sharp point so often found on acorns can be modelled. The opposite end of the nut is rough. Obtain this as in the orange, but with lighter and overlapping taps. The cup and its stem should be modelled separately.

Other round fruits, such as cherries, plums, peaches, may be treated in a similar manner.

Banana: Work up a good cylinder, smaller than the intended model. For the ridges, take a small roll of clay, the size depending on the size of the ridge; place it where the ridge is to be, and work it well into the cylinder.

Pods: (Peas or Beans) Make a cylinder and flatten it by pressure into a smaller shape than the desired model. For the mounds made by the peas and beans, take small balls, place them in position, and work well into the flattened cylinder. To form the seam at the back of the pod make two lines with a pointed tool, imitate the original.

Animal Shapes: These partake largely of the ovate form, and the attention of the pupils should be drawn to this. At this stage only bold, general shapes should be attempted. Select only familiar animals.

SAND TABLE

The sand table is a valuable adjunct in primary modelling. It is best to have, if possible, a table large enough for the whole class to work at, but a smaller one where three or four pupils can work at a time will serve, the others looking on and waiting their turn, or making various articles to be used in the general project.

In any class exercise every pupil should be given an opportunity to do some part of the work. In the building up of a project many materials may be used with advantage—toy animals to represent cows, sheep, hens, chickens, etc.; stones and pebbles for rocks; sticks and twigs for fences; water for brooks and ponds; small twigs and branches for trees; dolls, and toys. For many uses, the sand should be slightly dampened.

Preparation of materials for a sand-table project will furnish work for some time. The project having been chosen, the separate units should be taken up and taught in detail, after which the pupils should be encouraged to suggest additions and variations. When articles are completed, they may be placed in the position thought best. As fresh objects are made, they should be added, the pupils being allowed to arrange and re-arrange as they desire. When materials sufficient to portray the whole scene have been accumulated, the final arrangement may be made.

If the project is a farmyard scene, various geographical facts are introduced as the landscape is worked up in relief. The fencing is then done, and the division made into roadways, wooded land, pasture, orchards, etc. The farmhouses, barns, pig-pens, chicken houses, stables, dog kennel, windmill, well, and pump should then be placed. As succeeding objects, such as sheds, animals, and farm implements are finished, additions are made to the scene until the whole is complete.

This project is typical. Many other subjects taken from the Readers or the actual experience of the pupil may be treated in the same manner.

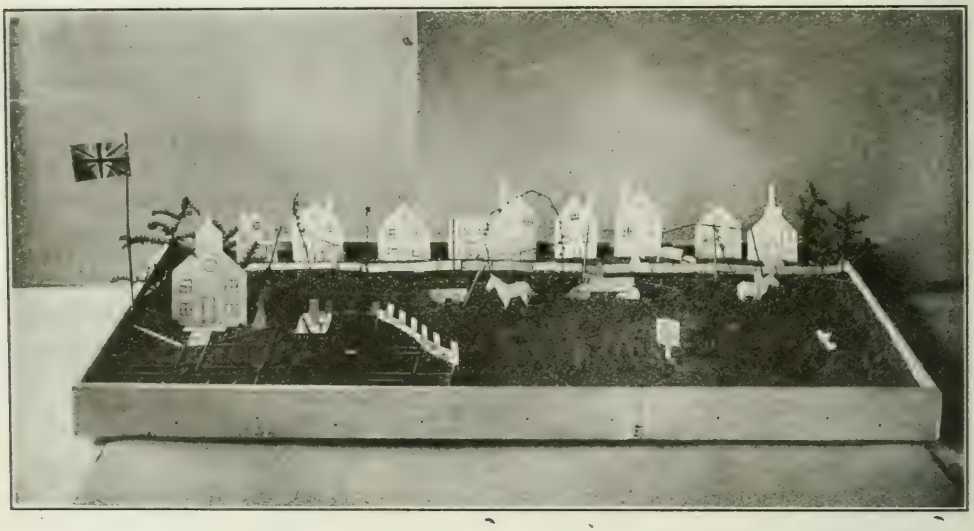


Plate 10.—Primary sand-table work.

Plate 11.—Advanced sand-table work.

PAPER CUTTING

First Step:

Let the pupils cut pictures from magazines, catalogues, newspapers, etc., in order to familiarize them with the use of scissors. The cut should begin near the joint and continue to within a short distance of the point of the scissors. A cut the entire length of the blade will leave a torn place or notch. Short, jerky cuts lead to unsatisfactory results. These pictures may be kept in an envelope, and, if carefully selected, will be of use later in other studies.

Second Step:

Allow the pupils to cut representations of objects that particularly appeal to them; such as toys, furniture, tools, animals, landscapes. Young pupils cut more easily and readily than they draw, hence this work should precede drawing.

THIRD STEP:

This step may take the form of cutting from silhouettes placed on the blackboard by the teacher in illustrating lessons in other school subjects. In these drawings, too much detail should not be attempted. If care be taken to discourage fine work and to encourage large, bold cuttings, there will be no danger of eye or muscular strain.

FOURTH STEP—Cutting from Memory:

1. The pupils are asked to close their eyes and picture to themselves the thing they desire to cut. When a clear mental picture is formed, the eyes are opened, and the pupils proceed to cut.

2. Place an object before the pupils for a short time for close observation, remove the object, and require the shape to be cut as remembered.

3. Combine cutting from memory and cutting from objects to make pictures illustrating various subjects, such as "Blowing bubbles", "Feeding the chickens", "Skating", "Skipping".

FIFTH STEP—Cutting from the Pose:

No branch of this work proves of greater interest to the pupil than the attempt to cut a picture representing a position taken up or an action being performed by one of his class-mates. This method should be resorted to frequently.

SIXTH STEP—Story Telling:

The pupils will now have acquired some facility in cutting and mounting and will be able to undertake the illustration of simple stories.

The following suggestions are offered for cutting—

Cinderella—

Objects which may be used afterwards for making pictures—fireplace, broom, table, chairs, Cinderella, Fairy Godmother, pumpkin, mousetrap, mice, rats, three-legged stools, etc.

Pictures may be cut to represent—

1. A kitchen scene,
2. Cinderella driving to the ball in a carriage,
3. Cinderella meeting the Prince,
4. Cinderella leaving the ball-room; glass slipper left on the stairs,
5. Herald and pages bearing glass slipper on a cushion,
6. Ugly sisters trying on the slipper,
7. Cinderella and the Prince.

The Three Bears—

If preferred, the bears may be cut with a Teddy Bear model in front of the class. Separate cuttings may be made of the bears, beds, chairs, bowls, spoons, garden gate, flowers growing in the garden, trees in the woods, Goldie Locks' swing and some of her toys, and these may be afterwards combined with pictures.

Pictures may be made as follows—

1. Goldie-Locks running out of the garden chasing a butterfly. This might be a simple scene, showing a girl running, fence, trees, and open door. The door panels can be made in coloured paper, or cut out, leaving the background to show through.

2. The three bears preparing to go out for a walk. The table could be made of strips, and the three bowls placed upon it. Father Bear is looking at the weather to see if it is fit to go out, and Mother Bear is calling to Baby Bear to make haste and come along while the soup is cooling.

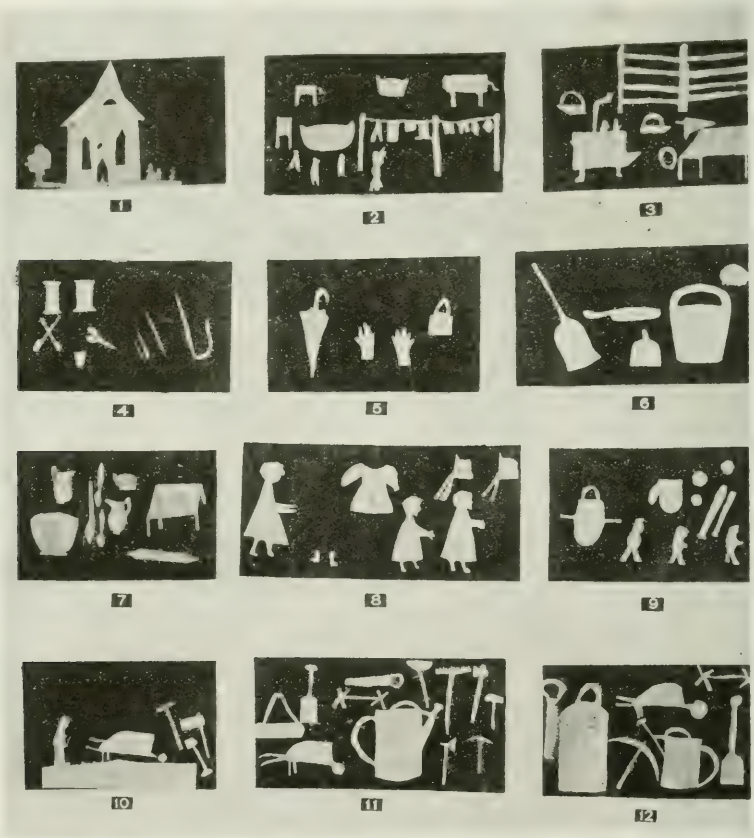


Plate 12.—Illustrative paper cuttings

Three Little Pigs—

The three pigs, load of hay, load of sticks, load of bricks, man, cart, wolf, house, apples, turnips, objects at the fair, churn, etc., may all be cut.

Pictures may be made as follows—

1. Pig meeting a man with a load of hay, sticks, or bricks,
2. The wolf knocking at the door of little Piggy's house, with the pig leaning out of the window,
3. A scene in the turnip field, orchard, or at the farm,
4. Churn rolling down the hill, with the wolf in flight.

In many of the above pictures, irregular and soft edges are required. To represent such subjects as the horizon, clouds, trees in leaf, etc., the paper should be torn rather than cut.

CUTTING BALANCED FORMS

Symmetrical or balanced forms are obtained by folding the paper once. This axial line may be either vertical, as in a bell, a Christmas tree, a canoe, a heart, a vase, a bowl, a hat, or in the letters A, M, T, V; or horizontal, as in the letters B, C, D, E. The shapes of many common leaves may be cut in this way.

Some objects will require both a vertical and a horizontal fold. This will be the case in cutting a picture-frame, a rolling-pin, a calendar mount, a star, and certain letters of the alphabet, as H, O, X.

MOUNTING

When the pupil has had practice in grouping his cuttings, let him mount them on a background of suitable colour. Good results can be obtained from the use of the softer or dull shades of common brown or gray wrapping-paper for these mounts.

CLASS SCRAP-BOOKS

Each grade should have a class scrap-book. In the Primary classes this would form a sort of supplementary reader or reference book, consisting largely of pictures relating to various phases of the school work. In all cases, before anything is pasted in the scrap-book, it should be submitted to the teacher.

In addition to the class scrap-book, each pupil should be encouraged to keep one of his own. The teacher should seek to influence the pupils as far as possible in their choice of pictures and subjects.

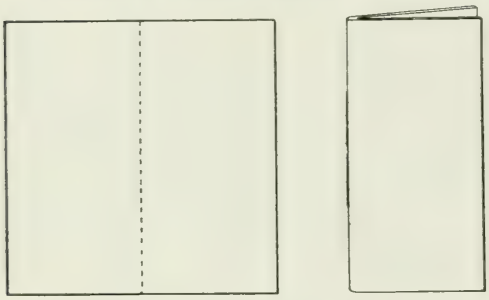
PAPER FOLDING

Paper folding is really a kind of drawing, the lines being formed by creases in the paper instead of by a pencil. Some of these creased patterns form drawings from which a large number of articles may be constructed.

As paper folding is sometimes done from direction, the pupils should all place their papers in similar positions. Arrange the papers on the desk with one edge parallel to the front. In this position elicit the names of the edges and corners, as upper edge, right-hand upper corner, left-hand lower corner, etc.

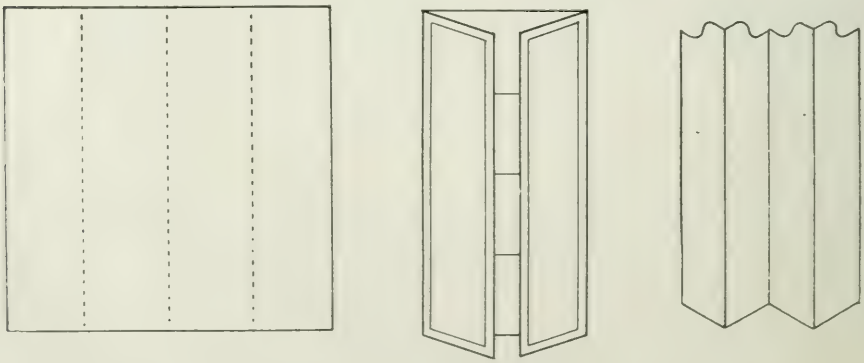
Fold the paper with both hands and in all directions. Check the habit of always folding with the same hand and in the same direction. Let each fold represent something to the pupils; they are making things, not folding papers. Thus, papers in position; fold right edge over to the left edge; crease. What is this? A book or a screen. Read something from memory from your little book. See if you can make a book at home and find out how to fasten the pages to the cover. Find a picture to paste on the cover.

What is a screen used for? Imagine something behind the screen.

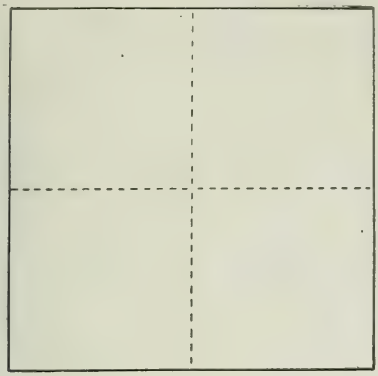


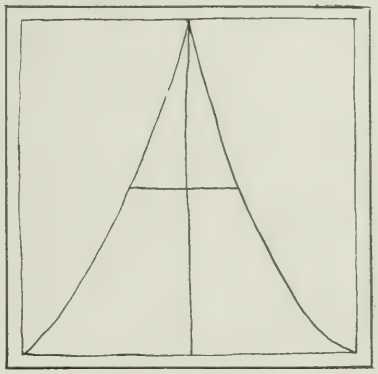
Fold paper into four equal parts. What does this look like? A window. How can we make it look more like a window? Draw on the black-board, sketching in curtains, and ask the pupils to make the drawings on their folded papers, using the edges and creases as guiding lines. Then draw a plant, pot, or anything else the pupils like on the window-sill. See if you can make another window. Cut out curtains from catalogues and paste them on your window.

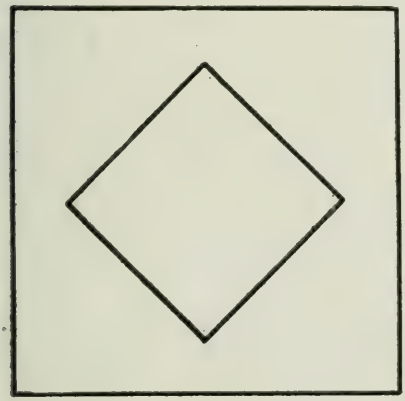
To the pupil this fold may also represent a mat, the edges being cut to form a fringe; or it may represent a chicken coop—toothpicks, pea-sticks, or strips of paper being used to represent slats. Other simple objects, such as shawls, sails, tables, toboggans, parasols, etc., may be represented by various folds.

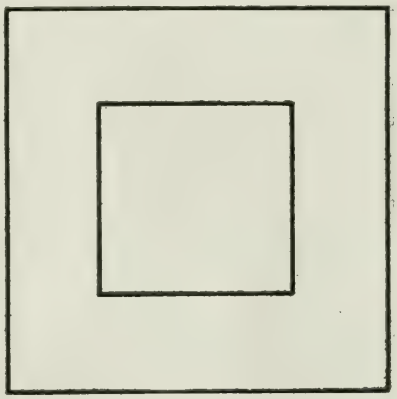


The common geometrical figures may all be made by folding the square. Many new terms will be employed—diameter, diagonal, angle, etc. Constant repetition of these will fix the meanings on the mind of the pupils.

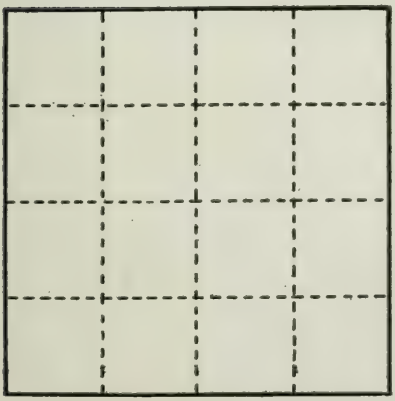








OBJECTS BASED ON THE SQUARE



Fold the paper into sixteen squares. This is commonly called the "checker-board". Colour alternate squares. Cut into sixteen separate squares. Use these squares for exercises in number work and continue the designing as in the window patterns.

ILLUSTRATIVE LESSON

The "checker-board" is the foundation form from which many objects may be made. The teacher will do well to devote considerable attention to her method of development. The following is suggestive:

Distribute squares with 8-inch sides; let the pupils observe the number and length of the sides. Opposite sides are equal. All four sides are equal. Compare the corners. They are all equal. This figure is a square. Write the name on the board.

How may the square be divided into two equal parts? By folding. Fold the bottom edge of the square so that it lies exactly along the top edge. Crease. Move your finger along these edges. What do you find? One lies exactly upon the other. We may call that a double edge. What shall we call the edge underneath? The lower edge. What shall we call the edge which covers the lower edge? The upper edge. What has happened to the left edge? One half of it has been folded on the other half. Open out the square and observe the crease. What does it look like? A straight line. Where does it lie. Between the middle points of the right and left edges. How does it divide the square? Into two equal parts. What part of the square is each part? One half.

What else has the crease divided exactly? The left and right edges of the paper. What is the length of each half side? Four inches. Set down on your paper, "One half of 8 inches is 4 inches".

What is the length of the crease? Eight inches. Fold the bottom edge to the crease and the top edge to the crease. Into how many parts is the square now divided? Four. What is the length of each long side? Eight inches. What is the length of each short side? Two inches.

Without turning the paper, fold the right-hand edge over to the left-hand edge. Into how many parts is the square now divided? Eight. What is the length of the long side of one of these eight parts? Four inches. What is the length of the short side? Two inches.

Fold the right and left edges to the crease just made. Into how many parts is the square now divided? Sixteen. Number them with your pencil. Take one of the sixteen parts and tell the length of each side. Two inches.

Compare the square corners. They are all alike. What can you call each one of these sixteen figures? A square. How many of these make up the big square? Sixteen. How many make up half of it? Eight. How many make up a quarter of it? Four.

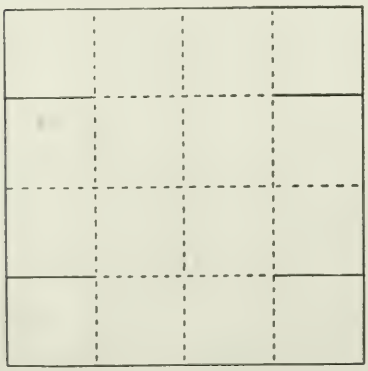
From this checker-board we will some other day make boxes, wall pockets, barns, fireplaces, tents, chairs, and tables.

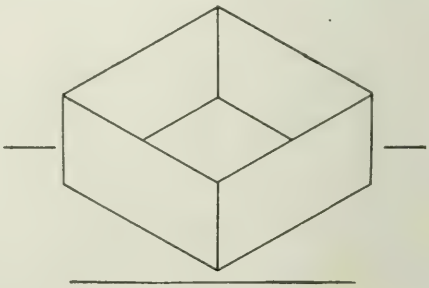
The teacher need hardly be reminded that in this exercise the pupils have been learning incidentally, but in a concrete and practical way, the relations of the numbers 2, 4, 8, and 16.

Box:

Cut along the heavy lines indicated in the drawing. Fold and paste.

The teacher should place a drawing of the folds on the black-board, showing very clearly the lines to be cut.





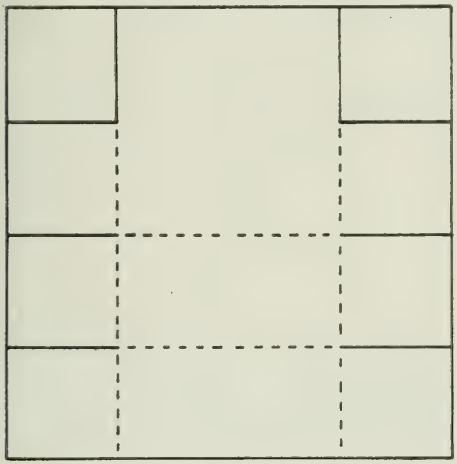
Turned upside down, this will represent a table. The pupils will suggest cutting out a portion of the sides to form legs, or separate legs may be pasted on. A somewhat larger square pasted on the top is an improvement.

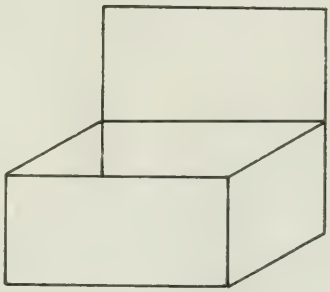
Add wheels and two strips of paper to the box to form shafts, and a cart is made. This method should be adopted wherever possible, and the pupils should be always encouraged to suggest modifications and improvements.

Wall Pocket:

Fold the checker-board. Cut out two upper corner squares and make other cuts as shown in the diagram. Fold and fasten (paste or paper fasteners).

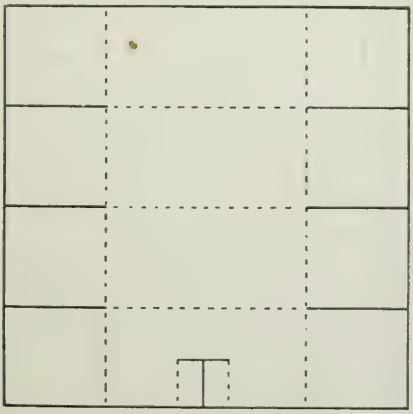
This may be an oblong box with a lid, or a cupboard with a door; two pasted together back to back form a knife-box. The back may be strengthened by pasting another thickness of paper over it.

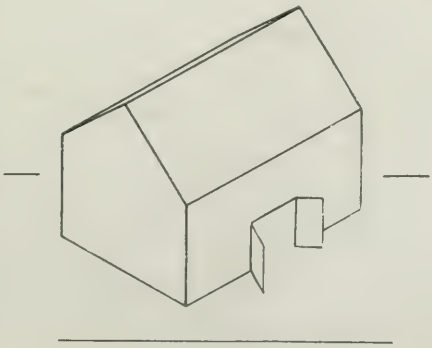




Barn:

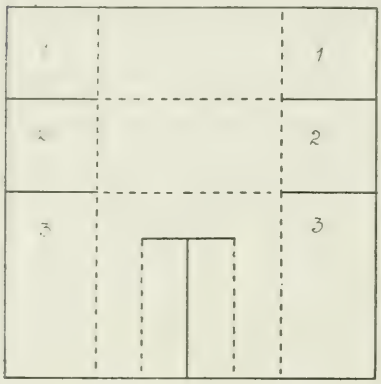
Fold the checker-board. Cut as shown. Paste the two inner squares on each side over each other and thus form the roof. Bring the corner squares at each side inward, and paste, taking care to have their lower edges in the same straight line. Fold the doors back.

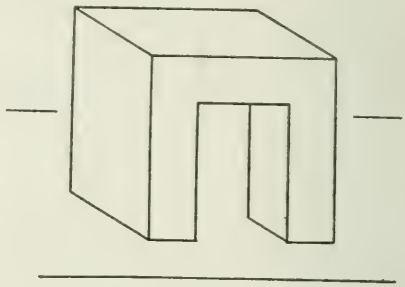




Fireplace:

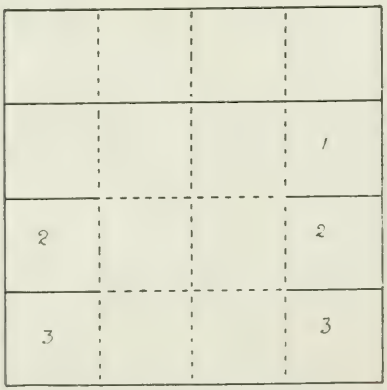
Fold the checker-board. Cut on heavy lines as shown. Fold squares 1 and 3 over 2, and paste. Fold back the opening for the fire.

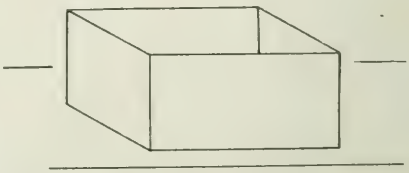




Oblong Box:

Fold the checker-board. Cut off one row of squares, thus leaving twelve squares. (The strip cut off may be used for additions required to complete the various articles, as wheels and shafts, backs for sofa, couches, wash-stands, bureaus, and cupboards.)



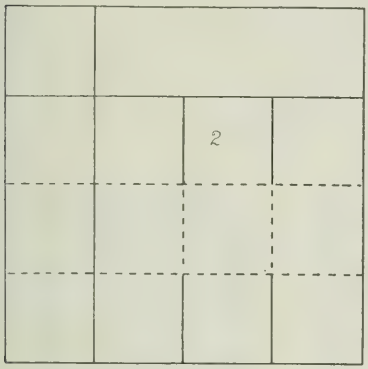


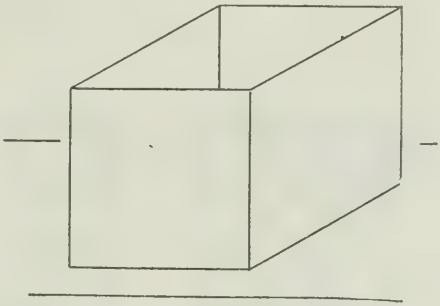
Cut on the lines as shown. Fold and paste. This will form an oblong box, or, turned upside down, a stool. Legs may be cut out, as in the case of the table. By folding square 1 over 3, and rolling square 2 over on the top, it makes a couch.

Other articles that can be made from this fold are—couch, basket with sloping sides, bodies of wash-stands, bureaus, sofas, cradles, cupboards, beds, carts, wagons, street-cars, coaches, bookshelves.

Cubical Box:

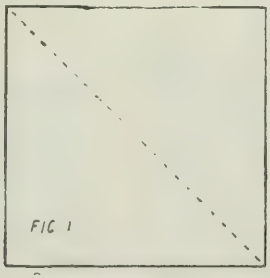
Fold the checker-board. Cut off a strip of four squares and then one strip of three squares, thus leaving nine squares. Cut along the lines shown. Fold and paste. This fold may be used to make a cubical box, or, by folding square 2 upward, a chair is formed.

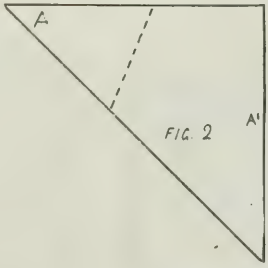


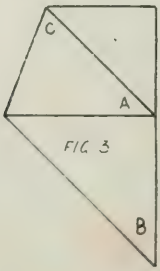


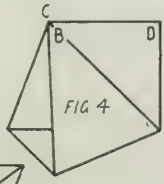
Drinking Cup:

Take a square of paper any size and fold along one diagonal, (Fig. 1). Fold corner marked A to touch opposite side near the middle, (Figs. 2 and 3). Fold corner B to C (Fig. 4), over the double fold; and fold the second corner, D, to the back. This object also makes a good plant pot for seedlings.





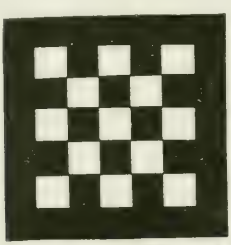




WEAVING

Weaving is one of the oldest industries and one of the first occupations of all primitive peoples. The foundation material is called the "warp", and the material threaded over and under the warp threads is called the " woof ", or " weft ".

For the first lesson, provide the pupils with paper warp and woof prepared by the older pupils. After they have used these once or twice, they will be able to prepare the material for themselves. To do this have them fold a square of black or coloured paper into the cupboard or screen form (four oblongs); then fold each oblong into two lengthwise, making eight strips. Cut out these eight strips for the woof, or weft. To make the warp, fold another square of white



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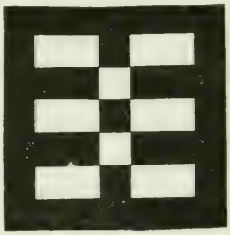

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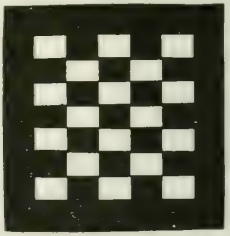

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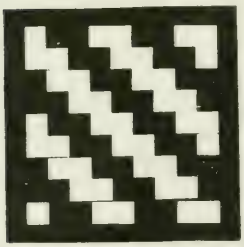

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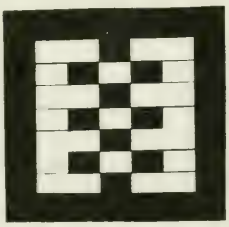

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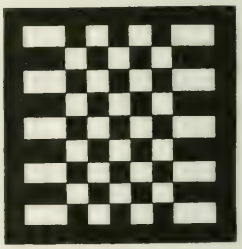

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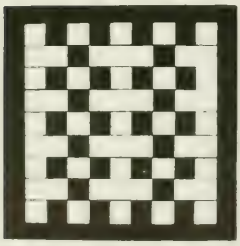

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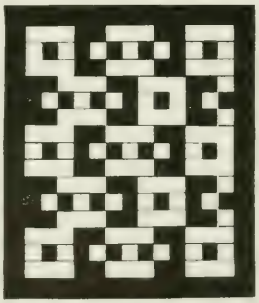

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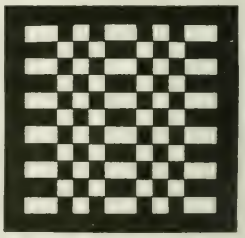

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paper in the same way; then fold across the creases and keep the paper doubled. This will have to be cut along the creases, beginning at the closed edge, cutting toward the open edges. To find just how far to cut, take a strip of the woof, place it along the outer edge, and make a pencil dot where the strip crosses each crease, then cut to the mark, and you have the warp. The strips of woof

should be first woven in, under one and over one. From this the pupils may be easily led to see how the various designs are developed by weaving under one, over two, under two, over two, etc. To finish the mats, trim the projecting ends and fasten each strip in place by pasting along the margin on the wrong side. An infinite number of patterns may be made in this way. The pupils may be shown that the most intricate carpet patterns are founded on this principle.

After the mats are woven, they may be made into various articles, such as picture mounts, book covers, napkin-rings, book marks, tidies, match holders, hat-pin holders, small boxes, or other similar articles.

HOW TO CUT WARP AND WEFT

Provide the pupils with, or have them cut an 8-inch square of stiff paper. Measure one inch from each angle along each side. Connect opposite points. This will give a 6-inch inner square. Set off half-inch spaces along two of the opposite sides of this. Join the points. Cut along these lines with a sharp knife or fold the square along one diameter and cut with the scissors. This forms the warp.

For weft, or woof, cut twelve strips of a blending colour one half-inch wide and seven inches long.

The use of different coloured warp and weft affords an opportunity to teach a certain amount of colour harmony. Begin by using the standard colours with their tints and shades or with neutrals. Later, lead the pupils to the use of more pleasing combinations.

In commercial weaving, wool, cotton, silk, and linen are the chief materials used. The teacher here may give brief incidental talks on each of these materials, pointing out how they are obtained, where they are produced, and the places to which they are sent. In this connection the map should be used.

WORK IN RAFFIA

This material can be used either alone, as in mats, woven or knotted bags, soft-coil baskets, hats, cushions, braids; or in combination with other materials; for example, with cardboard foundations—as in napkin-rings, mats, boxes, pin-cushions, photograph frames, whisk holders, penwipers, etc.; or with rattan for Indian basket-work.

The material requires very little preparation. It is imported in bales made up of large plaits or braids. When these are unbraided and before they are divided into individual strands, wash out the dust by moving them about in water. Raffia should always be used in a moistened condition. If only a small amount is required, run the strand of raffia through the finger and thumb in a bowl of water. For larger quantities, soak for a short time in water. To secure good, even work, select strands of an even width. The pupils should learn to distinguish the root end, which is simply that portion of the cuticle from the base of the leaf. When raffia is to be pulled through close material, as in sewing and some forms of basketry, the root end must be inserted first or the raffia will ravel.

Wool, soft cord, carpet ravellings, strips of clean rags, yarn, dried grasses, may be all utilized for work of this character.

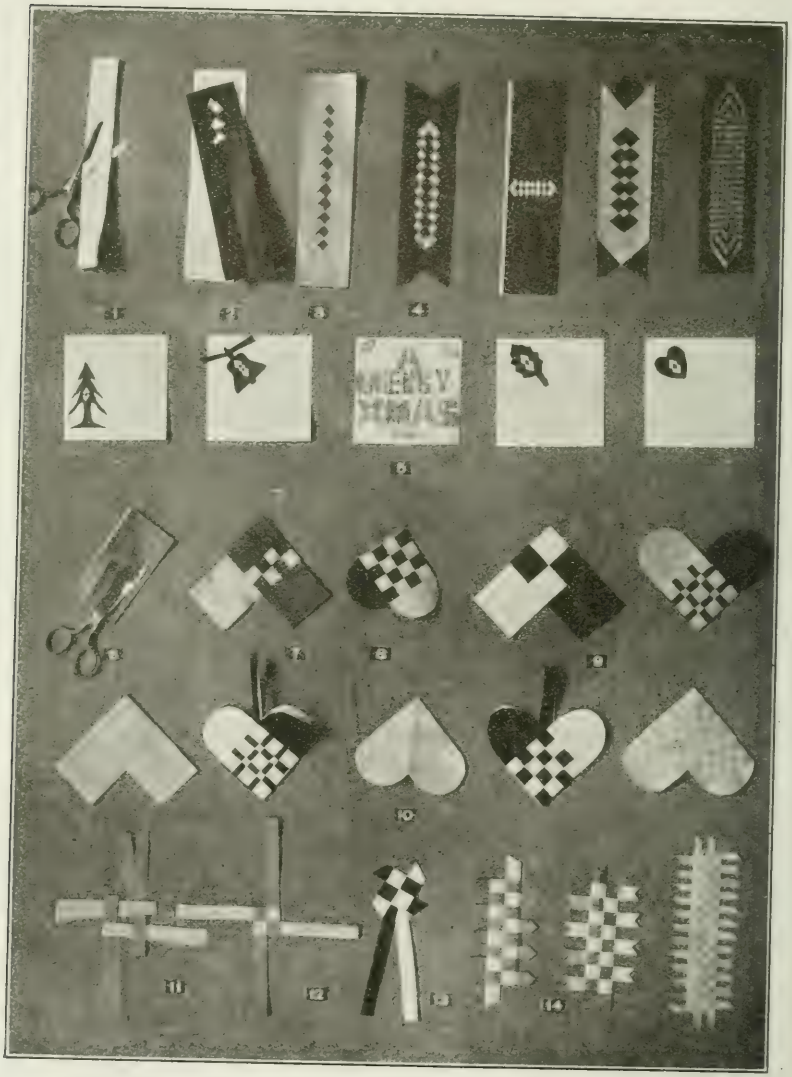
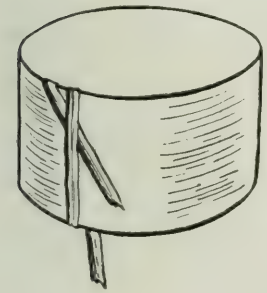


Plate 13.—Application of paper weaving

WINDING OR WRAPPING

This is one of the simplest methods of using these materials. It consists of covering some foundation (usually cardboard, splint, or rattan) by means of wrapping.



A napkin-ring makes a good first model. Take a strip of cardboard of the desired width and long enough to give two layers when coiled to the required diameter. These may be fastened so as to keep this shape. Moisten a piece of raffia and commence wrapping with the root end. If the end be overlapped as shown in the illustration, it will hold securely. Employ the same method when new strands are required.

To finish the wrapping, thread the last strand (using a No. 18 or 19 rug or tapestry needle), pass it under several layers, and cut off the waste material.

MATS

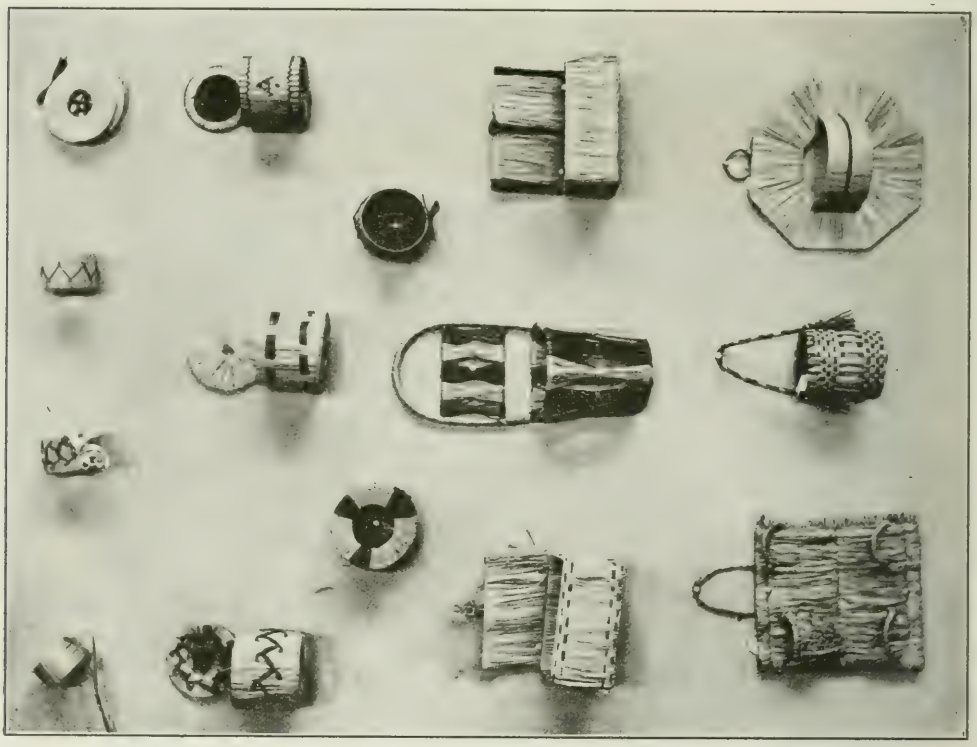
Mats can be made of various shapes by wrapping on a cardboard foundation. Cut a hole of the desired diameter in the centre of the shaped foundation. Cover with raffia or other material by passing the strands through the centre hole and over the outer edge. These mats can be used for various purposes, as mats for ink-wells, flower vases, ornaments, etc. Frames for pictures and photographs may also be treated in the same manner.

After braiding has been taught, borders or simple patterns may be added. The edges may be finished by overcasting, hemming, blanket, or button-hole stitch.

Mats and rings may be combined to form boxes and trays. A small mat with a peg through the centre will make a top. A small stick added to a shaped mat makes a fan. Two mats with a few layers of flannel between form a penwiper or needle-book. Oblong pieces of cardboard wrapped may be used for book covers, needle-cases, etc. The hinge may be formed by using herring-bone stitch. A number of round mats partially overlapping each other form a post-card holder.

BRAIDING

Many different weaves are used in braiding, but for school purposes the two described will be found sufficient. In the following analysis "right over" means that the strand held in the right hand is to be passed over the next strand, as in darning. This is intended to be repeated by the pupil as the braiding proceeds, until repetition is unnecessary.



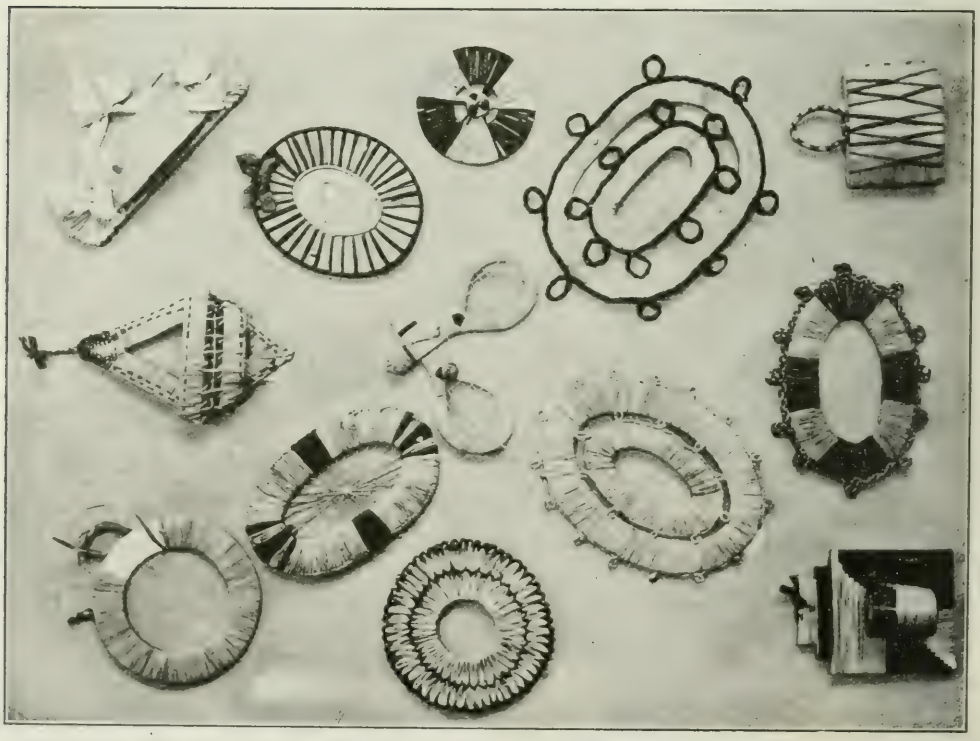


Plate 14.—Winding or wrapping

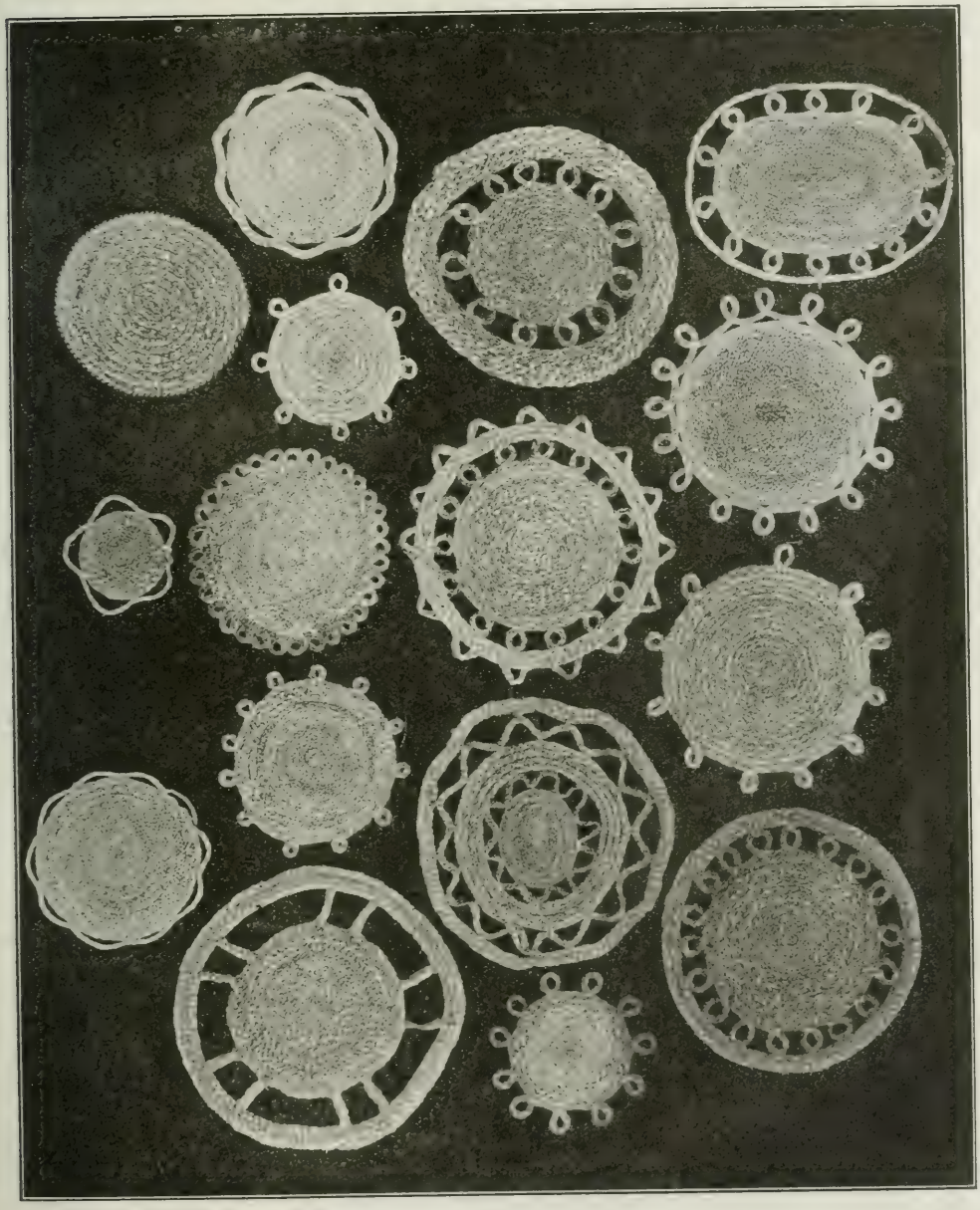


Plate 15.—Braided mats—Raffia

Analysis:

When an odd number of strands is to be braided:

For 3 strands: Right over,
Left over.

For 5 strands: Right over and under,
Left over and under.

It will be noticed that the weaving by both hands is similar.

When an even number of strands is to be braided:

For 4 strands: Right over,
Left under and over.

For 6 strands: Right over and under,
Left under and over and under.

Notice that in braiding with an even number of strands, if one hand begins the weaving by passing the strand *over,* the other hand will begin its share of the weaving by passing its first strand *under.*

When dealing with a large number of strands, the braiding may be done by taking the left-hand strand and weaving under and over toward the right in the usual way.

How to Commence:

Avoid the ugly knot so often used. Tie as shown in the illustration. Have the strands of different lengths, so that the introduction of new strands will not mar the evenness of the braid. Tie the work to any convenient object to hold it taut. To join, place the new strand alongside the other and braid with the two strands as if they were one. After braiding for a short distance, the waste end of the old strand may be cut off close to the braid. No knots are used. Raffia of different colours may be used in the same braid. Useful table mats may be made by sewing the braids edge to edge.

In making small hats or bonnets, begin at the centre of the crown and stitch the braid edge to edge. Moisten the braid and hold it in the desired position when the sewing is being done.

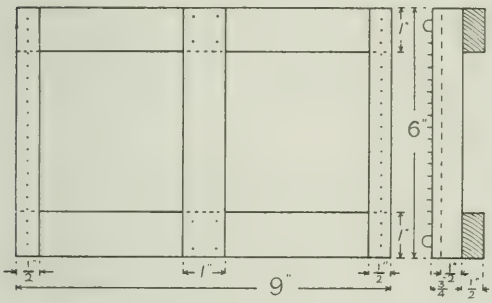
Wide braids may be used for belts and narrow ones for cords for various purposes.

Flat surfaces of all kinds may be made by stitching the braids edge to edge. These may then be made into many objects, such as needle-cases, handkerchief cases, small bags, book covers, etc.

SIMPLE LOOMS

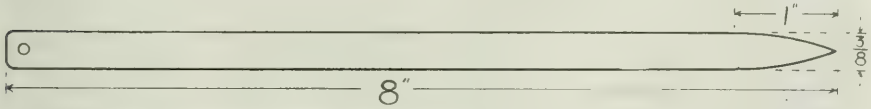
Four sticks tied together in the form of an Oxford frame make a simple loom upon which good work can be done. The frame of a broken slate makes a useful loom.

Cardboard looms of many shapes may be made by notching the board on opposite edges to hold the warp strands. A bead loom made from a cigar box serves for the weaving of belts, ties, or other narrow articles.



Directions for making a simple loom:

This loom consists of two strips of wood, ½ in. x 1 in. x 9 in., nailed to cross-pieces at the ends, ½ in. x ¾ in. x 6 in. A piece ½ in. x 1 in. x 6 in. is nailed across the middle to strengthen the frame.



EDGES SHOULD BE SLIGHTLY ROUNDED WITH SANDPAPER

A centre line should be drawn on the top edge of the cross end-pieces, and ¼ in. spaces marked off on this line. Half-inch finishing nails should be driven in, leaving the heads projecting ⅛ in. above the wood. Keep the nails in a straight line and the heads level. String the warp from the nails. The dimensions may be varied; a wider or longer loom may be required. A board, instead of strips, may be used for the bottom. A small staple may be substituted for the two nails at each end. Stiff wire or steel knitting-needles are slipped through the staples, and the weft, or woof is passed round the wire on each row. This helps to prevent the weft dragging the warp threads together in the middle.

A weaving needle may be made from a strip of thin wood. The edges of this should be slightly rounded with sand-paper.

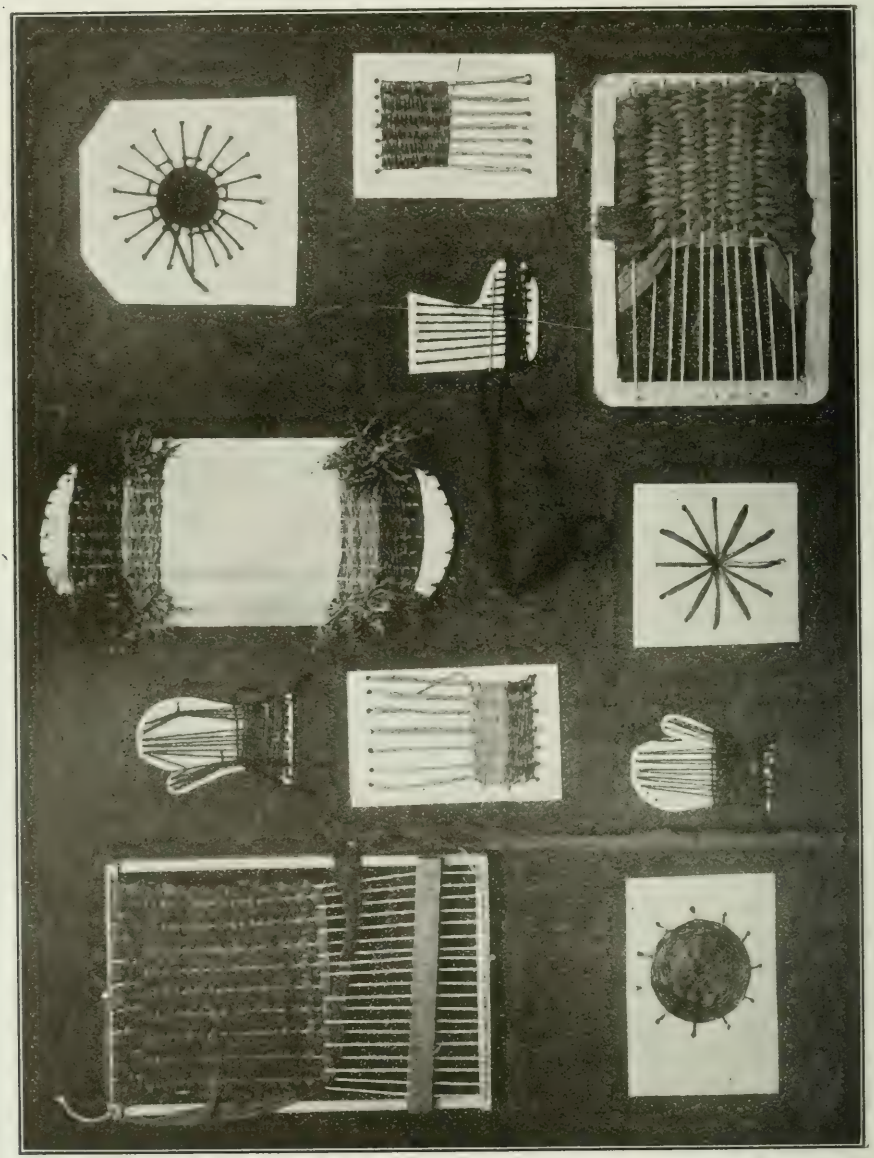


Plate 16.—Various looms

HOW TO PLAN SIMPLE WEAVES

A Plain Weave: This is made by using one colour only for the warp and one colour for the weft, the alternate warp strands being raised and lowered alternately, as in simple darning.

Stripes across the goods: Use a plain warp and weft of the colours desired for the stripes, which will be changed at regular intervals according to the width of the stripe required.

Stripes running lengthwise of the goods: In this case, reverse the order for the previous patterns. When stringing the warp strands, arrange them in the form of the stripes required and use only a plain weft.

Checks: The warp is arranged in dark and light stripes, and the weft is woven across in the same order as occurs in the warp.

Plaids: Use a striped warp, and weft strands of various colours changed at regular intervals. Other patterns may be made in a manner similar to that in paper-mat weaving, by passing the weft under or over a number of warp strands at the same time, to give the necessary length of colour required in that particular part of the pattern.

The teacher may design patterns for weaving, on paper ruled in small squares.

It should be understood that any suitable and available material, such as wool, clean rags, soft twine, silkoline, hemp, jute, rushes, may be used for weaving.

RAFFIA AND CANVAS

For little children, use coarse canvas. This forms a useful introduction to sewing, as many of the stitches may easily be taught on this material, for example, all the edge or border stitches, such as overcasting, blanket, button-hole, herring-bone, feather-stitch. As the canvas is large in the mesh, the number of spaces may readily be counted, and the stitches, which should be large, kept regular in size as well as in spacing.

Running, back-stitching, cross stitching, diagonal stitching, may be used for decoration or pattern effects. Needle-books, glove cases, blotters, handkerchief cases, bags, and many other useful and artistic objects may be made. Various designs for work of this kind are shown on pp. 41-49 of the *Ontario Teachers' Manual on Sewing*.

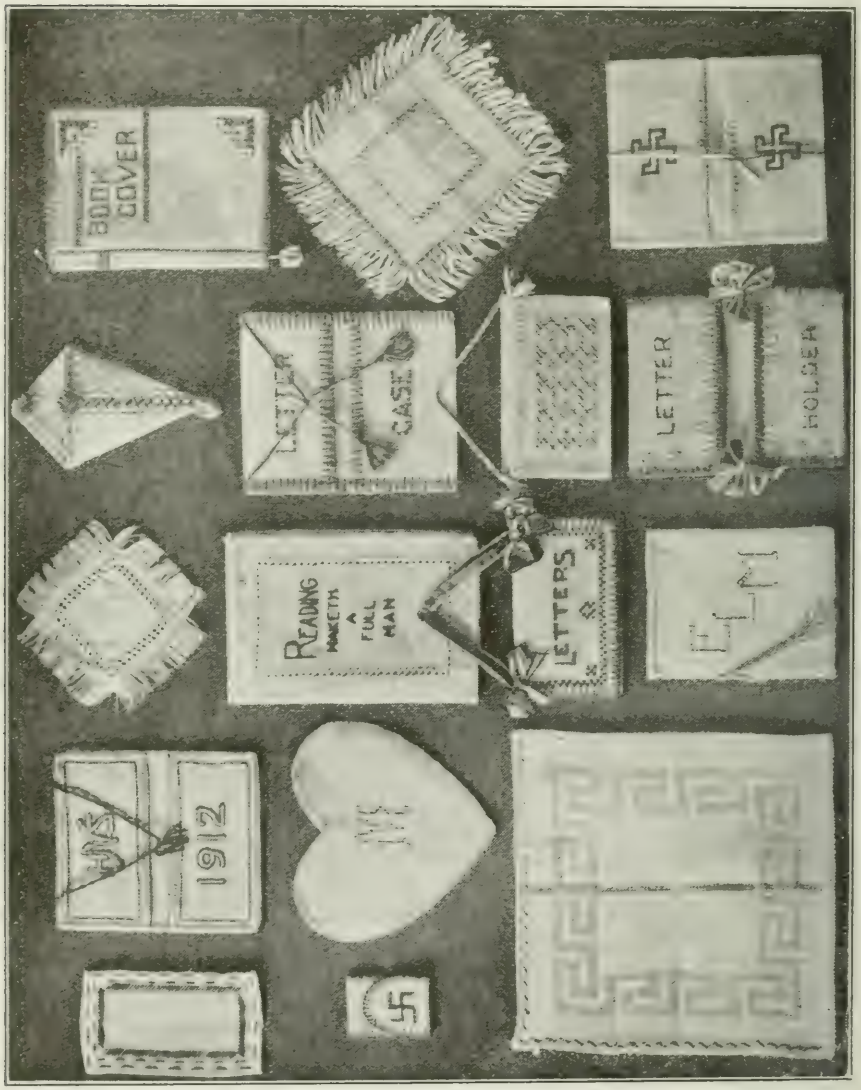


Plate 17.—Work in wool or raffia on canvas

FORM II

PLASTICINE AND CLAY MODELLING

Continue the free modelling in plasticine as outlined for Form I. An almost unlimited choice is afforded by the work in geography, history, nature study, and literature.

In geography, the lessons on various land and water formations, plants, and child life in other lands, suggest topics for modelling. Imaginary travels will provide material illustrative of the various modes of transportation. The clothing worn by the various peoples mentioned in the stories suggests the modelling of the animals or plants from which its materials are made.

History stories, in a similar manner, will offer opportunities for the modelling of forts, guns, shields, ancient and modern weapons of warfare, national costumes, the implements used by pioneers, and representations of their various pursuits and dwellings.

In nature study, insects, birds, animals, vegetables, and trees may be represented.

Wherever possible, good models or pictures should be provided, so that the pupils may study them in order to get clear ideas regarding general form. The teacher should call attention to the characteristics of the various parts, so that the pupils may study them more closely.

GENERAL DIRECTIONS FOR MODELLING

1. Build up by adding small pieces of clay well pressed together to a size rather smaller than the intended model, but having the same bold general character.
2. Go over it again, adding a little here and taking a little away there, and so get more detail. Continue this until the desired result is obtained.
3. The *position* of the clay model should always correspond to that of the original, when comparisons and observations are made.
4. Study the outline of the model from *all* directions.

To make a slab:

Take small pieces of clay and press them well together, so that no holes remain in the mass. Make the slab about half an inch thick.

Smooth the top with the side of the thumb, stroking first in one direction and then in the other.

Now turn the slab over, smooth the second side in the same way, and fill in any holes with additional clay.

Trim the edges, to get the desired size and shape.

Smooth the surface with a moist thumb or finger.

Later, when the slab is simply a foundation for a model, quicker methods can be adopted:

1. It may be rolled out, as in rolling out dough for a pie.
2. Two strips of wood, say ⅜ in. thick, may be placed on the modelling board at the requisite distance apart, and the space between filled by pressing

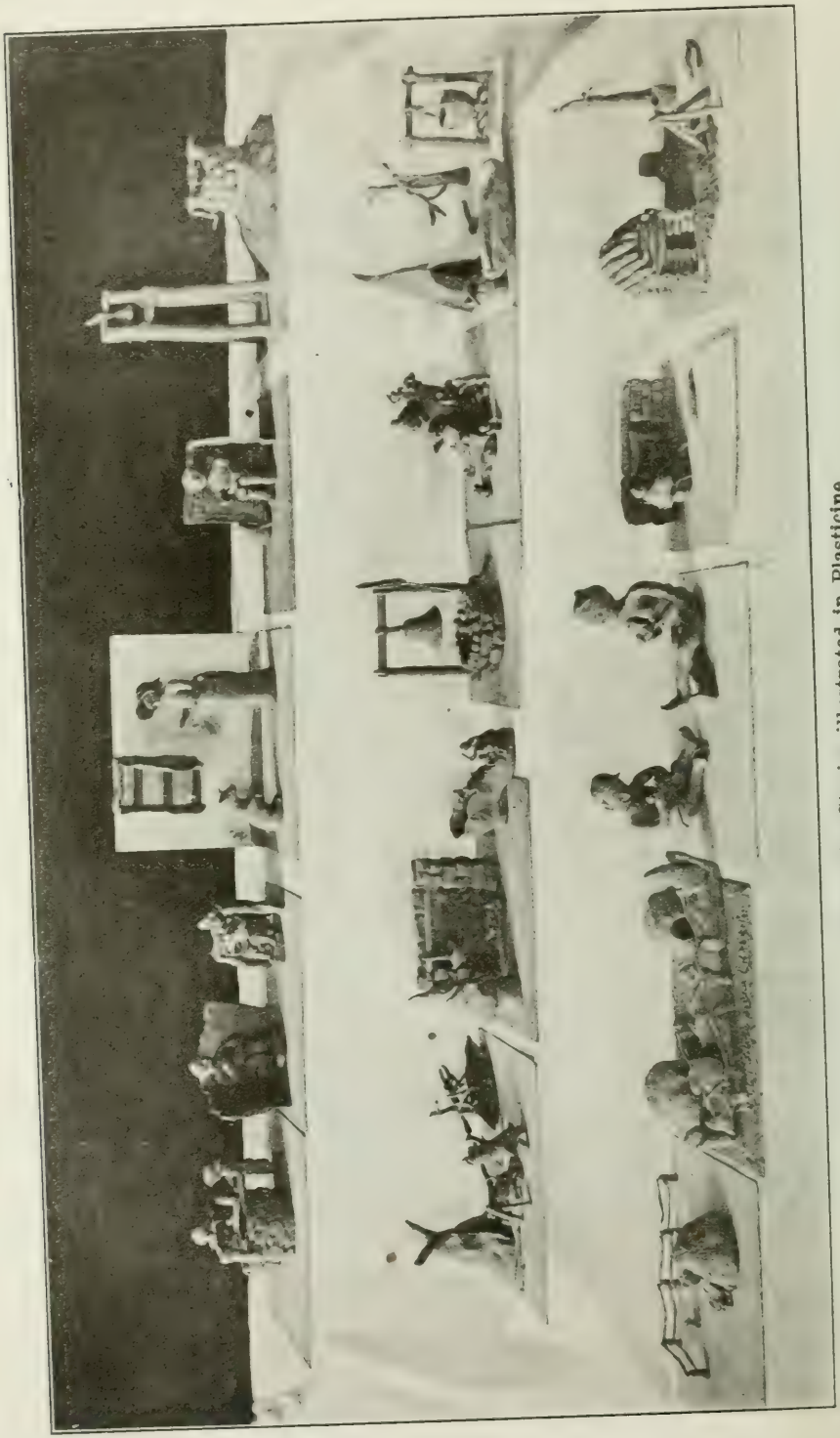


Plate 18.—Stories illustrated in Plasticine

Plate 19.—Stories illustrated in Plasticine

in small pieces of clay till the surface is slightly higher than the slats. Take a thin piece of wood or other scraper long enough to stretch across both slats, and, with light and frequent strokes, scrape the surface of the clay until it is level. Remove the slats and trim the edges not formed by the slats. The scraper should be sloped in the direction in which it is to be drawn.

These mechanical methods should not be used until the pupils have acquired some facility in modelling slabs. These are quick methods and are used to save time, so that more attention can be devoted to the modelling of the object which is to rest on the slab.

Tiles:

The slabs previously referred to may be formed into tiles which offer opportunities for design, either incised or in low relief. These, when fired, make serviceable stands for tea-pots, flower-pots, etc. In the case of young pupils, the patterns may be obtained by folding and cutting paper.

After the slab is made, apply the paper pattern, and take out, to an even depth, all the clay not covered by it. Leave a margin round the edge of the tile. Geometrical patterns may be obtained in this way, and the pupils may also learn the use of the "templet," or pattern, so common in the regular workshop.

At a later stage, patterns based on plant and flower formations may be used to great advantage; but in designing always bear in mind the use to which the object is to be put. If the tiles are to be used for tea-pot or other stands, the surface must be left comparatively flat, so that the object will rest firmly; but if the tiles are for decorative purposes only, the designs may be made in any degree of relief.

A circular dish:

Make a ball by pressing small pieces of clay well together and by rotating in the palms of the hands. Now flatten the ball on the board to make a thick disc, and press a hole in its centre by means of the thumbs, taking care not to press too deeply. In this manner spread out the sides of the disc to the required size (height and thickness of sides, and diameter of dish). Keep the sides and base about three eighths of an inch thick.

Press the extreme edge of the disc between the finger and thumb and reduce it to about one eighth of an inch in thickness. Smooth with a moist finger.

An oblong or square trough:

Make, of fairly firm clay, a base of the required size and about half an inch thick. Build up the sides in the usual manner with rather softer clay well kneaded. Smooth with a moist finger.

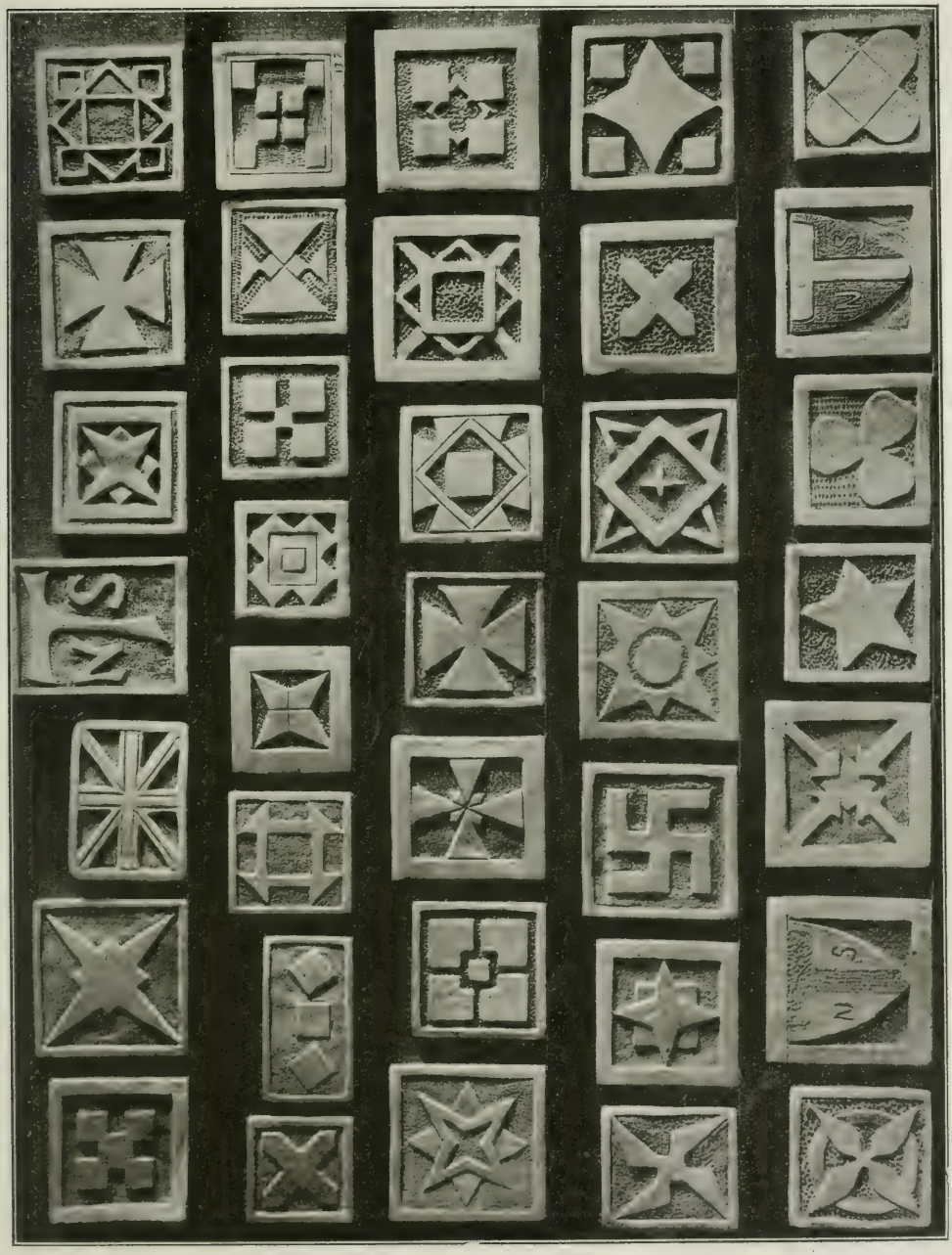


Plate 20.—Tiles

PAPER FOLDING AND CUTTING

FREE CUTTING

Continue the work in free cutting as outlined for Form I. Give greater attention to the arrangement of the various parts of the story. The figures should now be cut with that greater care which results from closer observation of characteristic features. The stories at this stage may be suggested by:

1. *Games and Sports—*

Base-ball, football, lawn tennis, hockey, cycling, boating, skipping, skating, tobogganing, marbles, etc.

2. *Trades and Occupations—*

Carpenter, builder, baker, milkman, iceman, shoemaker, gardener, postman, blacksmith, etc.

3. *Activities of the Home—*

Washing, ironing, baking, cleaning, visiting, mending, canning, going to church, etc.

4. *Geographical Illustrations—*

(1) Definitions: Island, lake, cape, bay, isthmus, peninsula, mountains, rivers, etc.

(2) Means of Transport: Ships, boats, trains, cars, animals used in transportation, motor vehicles, aeroplanes, etc.

(3) Productions: Typical natural and manufactured products together with the story of their making.

(4) National Costumes: Typical little folk, etc.

(5) Houses and dwellings of many lands.

5. *Special Seasons and Days—*

Thanksgiving Day, Christmas, New Year, Empire Day, Easter, Armistice Day, etc.

6. *Seasons—*

Spring: Catkins, chickens, buds, birds' nests, lambs, flowers, Easter cards, chicken peeping from the egg, etc.

Summer: In the park, feeding swans, sports, gathering flowers, etc.

Autumn: Harvest, fruit, birds, squirrels, autumn leaves which may be tinted, etc.

Winter: Snow, ice, Father Christmas, girl on skates, snow-shoeing, sleighing, reindeer, etc.

Many other suggestions for carrying on the work along these lines may be obtained from the Course of Study in Geography, History, and Nature Study for this Form.

The "centres of interest," such as the Farm, Foods, Transportation, etc., recommended for clay modelling in Form I may be used with advantage in this connection.

FOLDING FOR GEOMETRICAL UNITS

The following sequence of foldings will give various geometrical units which are of service in the formation of patterns and designs originated by the pupils themselves. If they work from different coloured sheets, they may exchange their units, and thus secure various colours for this pattern building.

1. *The Square*:

The checker-board is folded as in Form I, and the small squares are cut out. These units can be arranged in many ways.

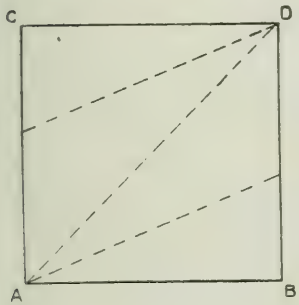
2. *The Oblong*:

These may be arranged as in No. 1 or combined with the square. Many other combinations may be seen in oil-cloths and linoleums.

3. *The Right-angled Triangle*:

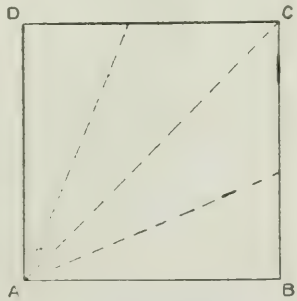
See common linoleum patterns for many other arrangements, especially when different colours are used.

The methods of folding the above are given in Form I.



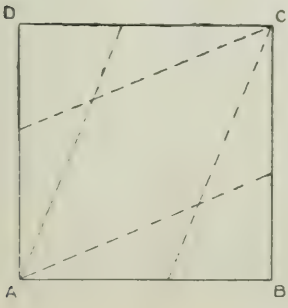
4. *The Rhomboid*:

Fold on the diagonal AD. Fold edge AB on the diagonal AD. Fold edge CD on the diagonal.



5. *The Trapezium*:

Fold for the diagonal AC. Unfold. Fold lower edge AB along the diagonal AC. Fold edge DA along the diagonal AC. This unit is well adapted for the formation of stars of various shapes.



6. *The Rhombus* (Diamond):

Fold edges AD and AB on the diagonal. Unfold. Fold edges CD and CB on this diagonal. The creases on the reverse side show the folds for the required figure.

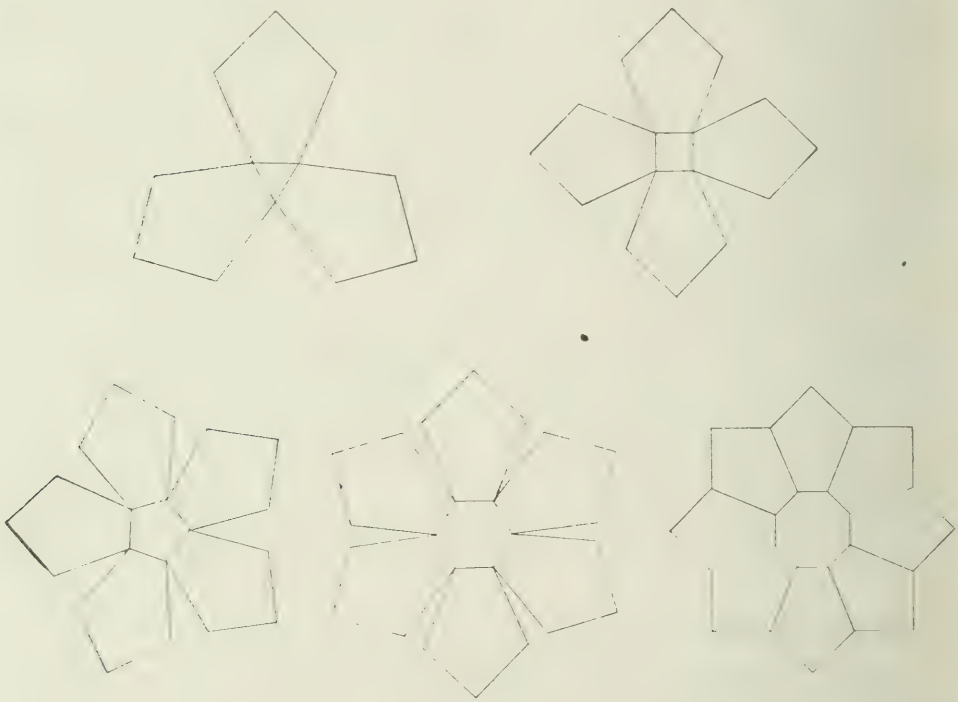
With this shape as a unit, build various border patterns as previously described.

7. *Irregular Pentagon*:

Fold one of the acute angles of the trapezium, or diamond, inward to the centre of the figure.

Using this as a unit, stars having from three to eight points may be built round any regular figure, up to the octagon, having sides equal to the smallest side of the pentagon.

An equilateral triangle gives a three-pointed star, a square gives a four-pointed star, a pentagon gives a five-pointed star, and so on.



(This unit is derived from the trapezium)

Other star formations may be made by building any number up to eight in such a way that their acute angles meet at a central point.

8. *Irregular Hexagon*:

Fold the acute angles of the irregular pentagon formed from the diamond to the centre of the figure.

Arrange six hexagons around one hexagon. Arrange eight hexagons around an octagon.

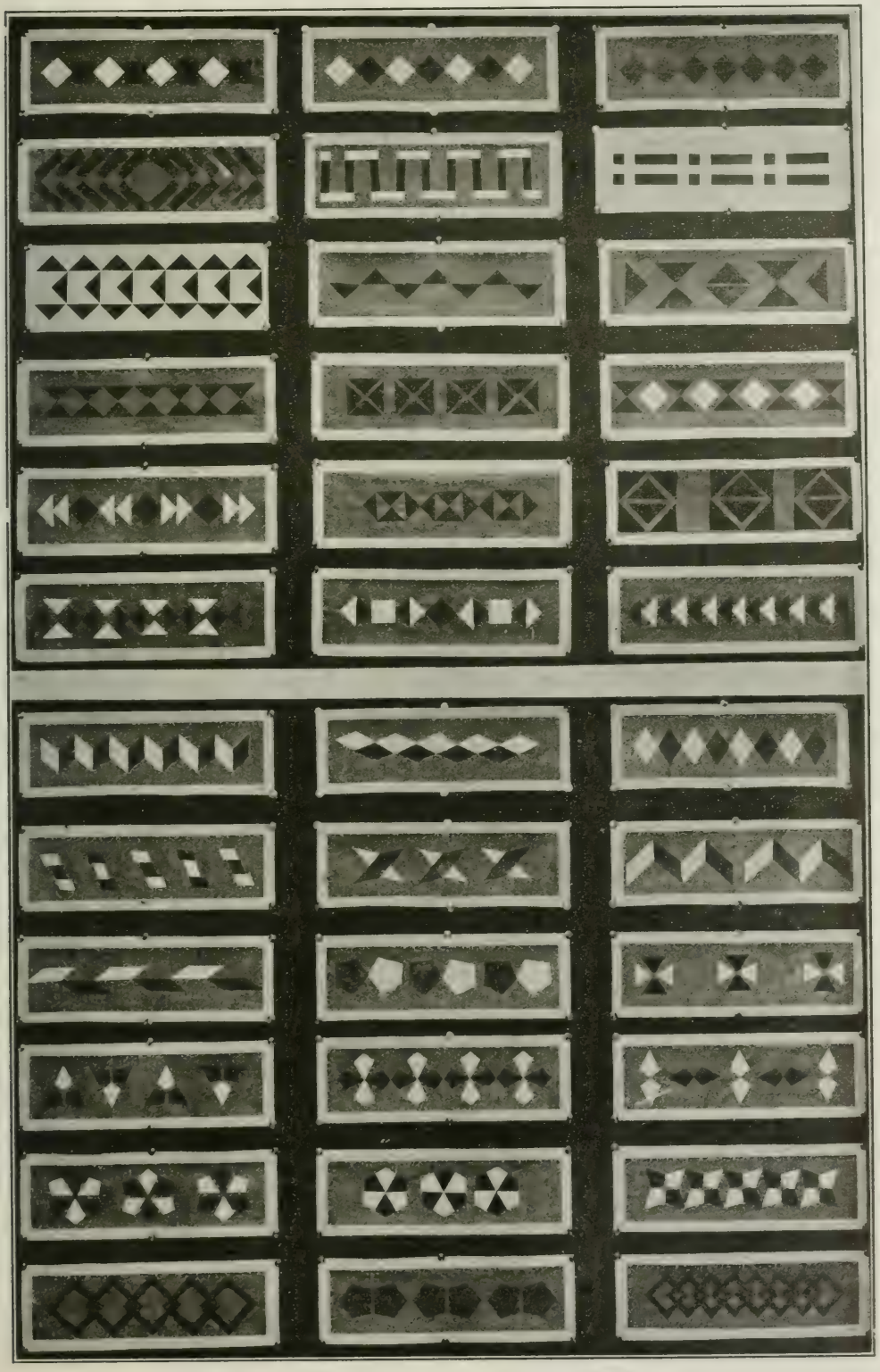
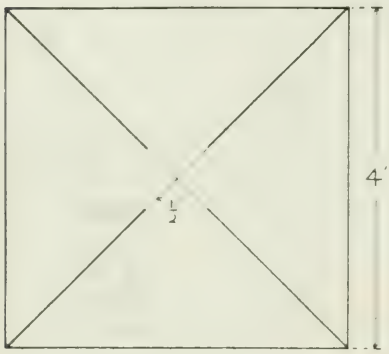


Plate 21.—Borders formed from geometrical units

OBJECTS MADE FROM PAPER

The following objects are to be made from heavy paper. Lines which were previously obtained by folding are now to be obtained by measuring and drawing. A preliminary lesson should be given on the main divisions and use of the rule. Take a strip of paper 8 in. long and about 1 in. wide. Fold into 8 equal parts. Each part is one inch. Fold the inch into halves. A home-made rule having a limited number of marks is much better for a beginning than a bought rule with its multiplicity of marks. The finer graduations are confusing to the young pupil. Add quarters and eighths in later exercises as they are needed. This work in paper forms an introduction to the series of cardboard models which follows:



1. *Windmill*:

With ruler and set-square (any object having one right angle, such as a machine-cut envelope or a visiting card may be used,) construct a square having 4-in. sides. Draw diagonals—and measure half an inch from the centre along each diagonal. Cut out the square. Cut along the diagonals to the half-inch mark. Roll the right-hand corner over and upward. Insert a pin through the ends of the wings and the centre of the square. Fasten to a stick.

Development of a Lesson on a Windmill

Show the completed model. What are windmills used for? Flatten the model out. What shape is it? Square. What must a square consist of? Four equal sides and four equal angles.

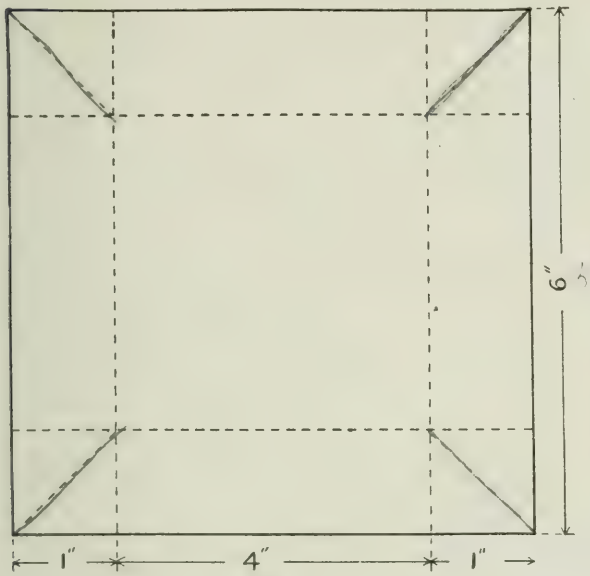
Where does the builder start in building a house? At the bottom. What is this called? The foundation. Draw a line four inches long near the bottom of the paper. Why four inches? Because the model is four inches square. Would any other length do as well? Yes. If we drew the base line six inches, what would that mean? Every other line would have to be six inches. From each end of this base line draw lines at right angles by the use of a visiting card, envelope, or set-square. Compare these two angles. They are equal. Make each of these lines four inches long. Why four inches? Because the base is four inches. Join the ends of these lines. What will be the length of this line? Test with the ruler. What is the completed figure? A square. What is a square?

Join two opposite corners. Into how many parts does this divide the square? Two. Compare them. They are equal in size. How can you test this? By folding. What is each part called? A triangle. Join the other two corners. How many parts now? Four. What is each shape called? A triangle. Compare sizes. They are all equal. What are the lines joining opposite corners called? Diagonals. How many diagonals has a square? Two. Why only two? Because the figure has only four corners. What are each of these corners called? Right angles. Compare the lengths of the diagonals. They are equal. What is the point where the diagonals cross? The centre of the square.

Cut from each corner along each diagonal to within half an inch of the centre. (Let the pupils finish the model from their observation of the specimen.) What will happen if the pin is fastened too tightly to the stick? The mill will not turn. Why?

The models made may be tested during recess. Have windmills made twice the size and half the size. Suggest other forms of windmills. Do you think your windmill will last very long? Could you make a stronger one? When you get home see if your father or big brother can help you to make one out of tin or wood.

A triangular basket may also be made with this construction. Fold the diagonals and cut along one diagonal to the centre of the square. Fold into shape. Make a handle with a strip of paper half an inch wide.

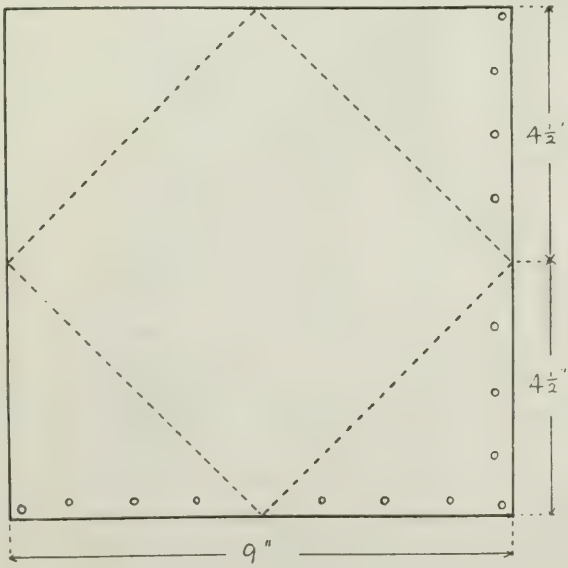


2. *Paper Box*:

Take a square of any size. Measure one inch from each angle along each side. Join opposite points. From the angles of the original square draw the diagonals of the four corner squares. Fold along the dotted lines, pinch the corners together, and tie or lace.

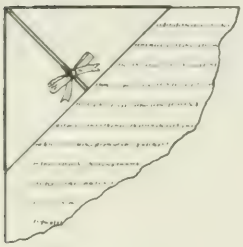
3. *Handkerchief Case*:

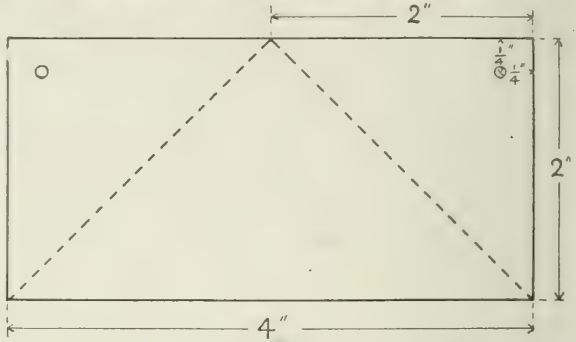
From stout paper or very thin cardboard cut a square having sides nine inches long. Find the centre of each side and join the points on adjacent sides. Punch holes. Fold the triangles to the centre of the square. Lace or tie.

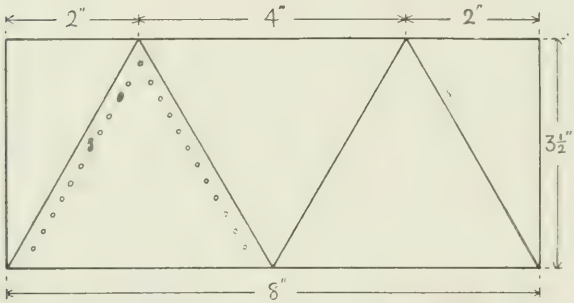


4. *Corner Bookmark*:

Make a rectangle 2 in. by 4 in. Find the centre of one of the long sides. Fold on the dotted lines, as shown in the diagram. Punch holes and tie.







5. *Twine Holder*:

Construct a rectangle 8 in by 3½ in. Divide the upper longer edge as shown. Obtain the middle point of the lower edge. Join these points. Cut into three equilateral triangles. Punch holes half an inch apart along two sides of each triangle. Tie together.

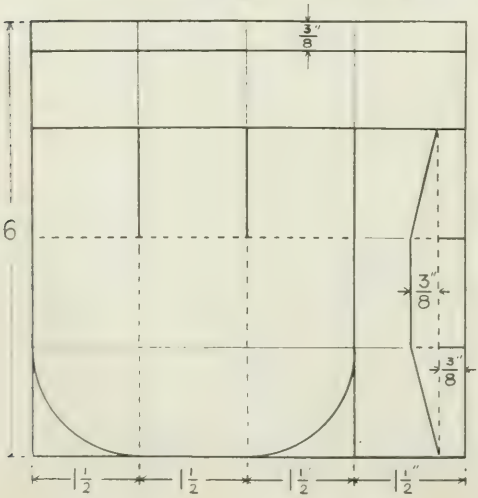
Place a ball of twine in the holder, allowing one end of the twine to pass through its point.

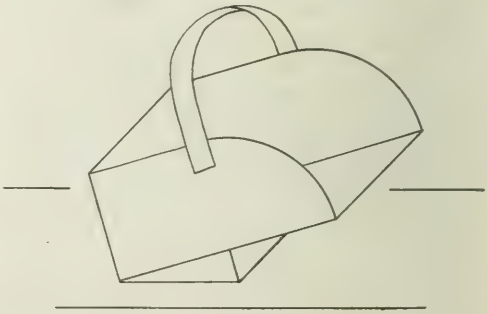
6. *Coal Box*:

Construct a square with 6-in. sides. Divide into sixteen equal squares by measurement.

Cut off one strip of four squares and then one strip of three squares. Draw and cut as shown.

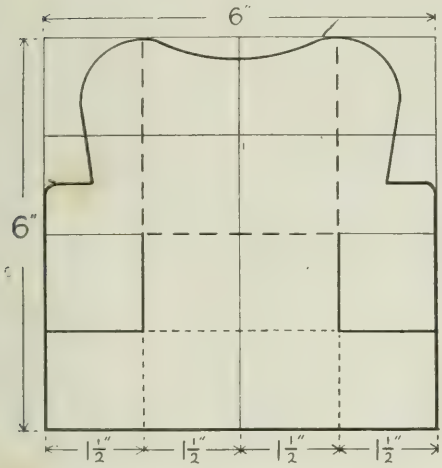
From the strips, cut off, draw, and cut the base and the handle. Fold and paste.

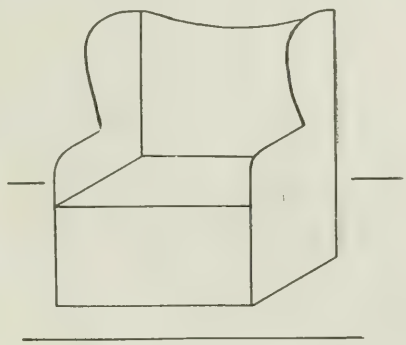




(7) *Settle*:

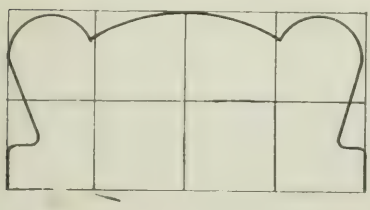
Construct a 6-in. square. Divide the opposite sides into 1½-in. spaces and join the points, thus dividing the large square into 16 smaller squares of 1½-in. sides. The design for the back and the arms may be modified if desired. The size also

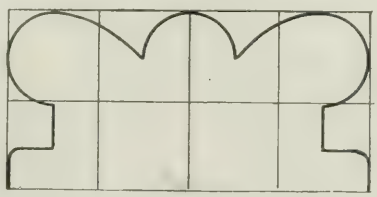




may be changed, if the same construction be followed. As the settle is a combined screen and seat the design should show no openings on the back.

Alternative designs are shown for the back. Fold a piece of paper and cut a pattern.



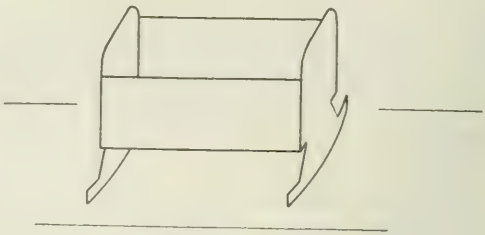


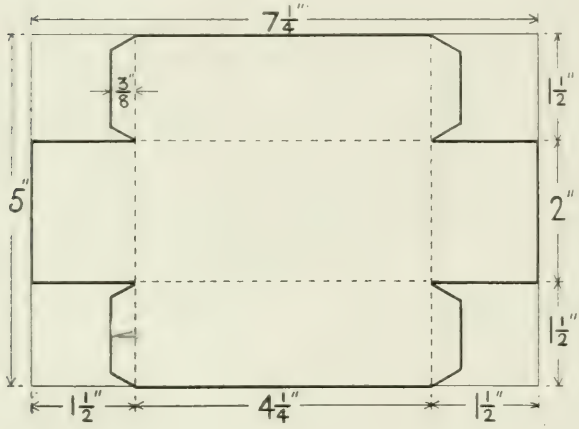
Cut and fold as indicated. Fasten with paste or paper fasteners.

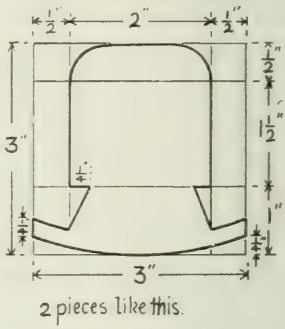
Note that the heavy lines are to be folded the opposite way to the lighter broken lines.

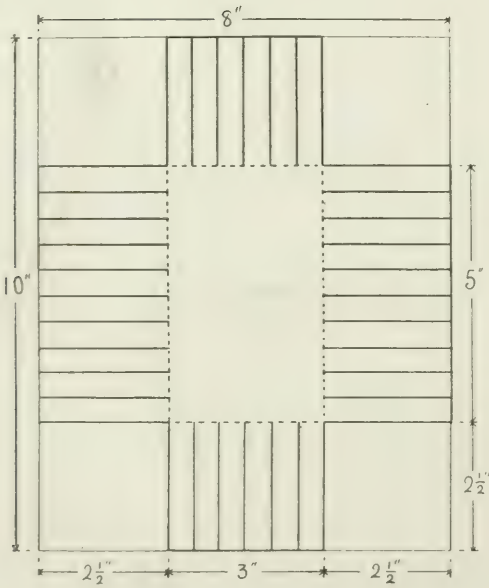
8. *Cradle*:

For the body of the cradle, construct an oblong 7¼ in. x 5 in. Draw as shown in the plan. Cut, fold, and paste to form an open oblong box. For the ends, cut two pieces as shown, or design the shape to suit. Paste the ends to the body of the cradle as shown.







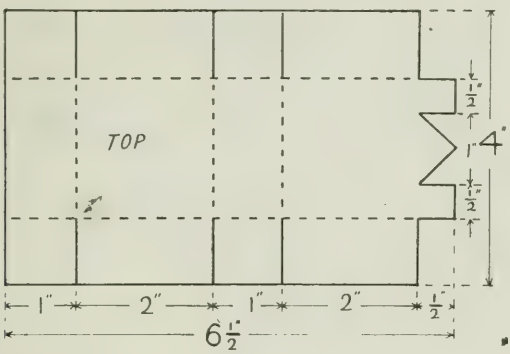


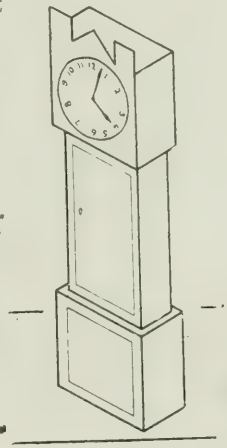
9. *Woven Basket*:

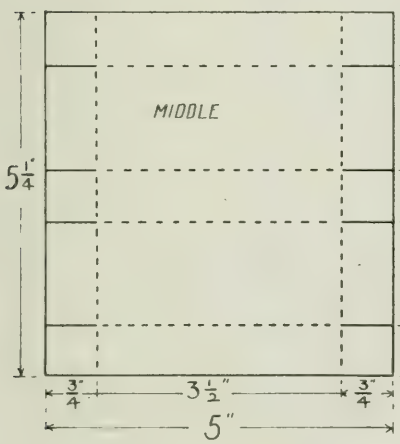
Draw a rectangle 8 in. x 10 in. From each angle measure 2½ in. along each side. Join these points and draw lines half an inch apart. Cut out the four corner squares and fold. Cut along the half-inch lines. Cut three strips half an inch wide. Weave in and out around the basket, slightly pasting each end. Bend the remaining portions of the vertical strips outward or finish as desired.

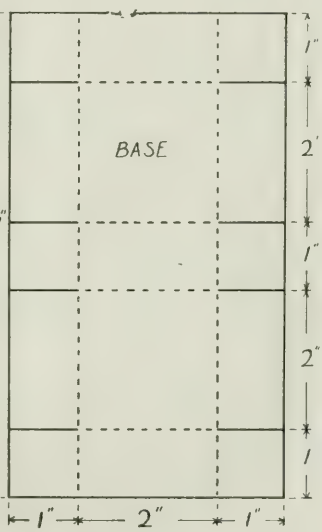
10. *Grandfather's Clock*:

This is made from three boxes pasted together. For the top make a closed box from a rectangle 4 in. x 6½ in. The dial may be cut from an advertisement and pasted on. The middle box is made from a rectangle 5 in. x 5¼ in. Panel the front side to represent a door. Make the base from a rectangle 4 in. x 7 in.



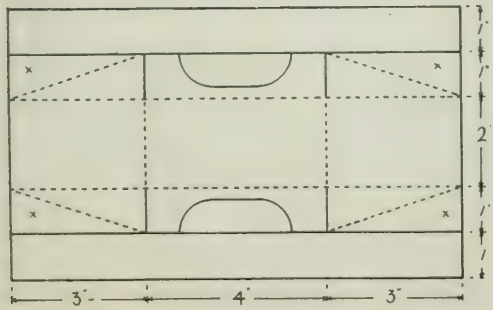






11. *Bridge*:

Draw as shown. The upper and lower strips are cut off and used for the walls, which may be designed as required. The parts marked X are folded underneath.



CARDBOARD CONSTRUCTION

This is a continuation of the work above outlined, but in the heavier material. The line of fold in cardboard construction must be partially cut through with a knife before folding. This is called *scoring*. Always fold away from the scored side. In the following drawings, the line to be scored is represented by a dotted line. The designs in most cases admit of modification and originality both in shape and decoration. Wherever possible, the pupils should be allowed to make deviations from the design in accordance with their conceptions of the requirements of the objects.

If properly taught, the pupils will become familiar with plans and elevations, and many opportunities are afforded to teach the practical geometry upon which the work is based.

Paper and cardboard models may often be improved in appearance and usefulness by some form of decoration. This should take a simple form in the earlier exercises, and may consist in the application of crayon, free cuttings, and pictures or designs worked in coloured paper. The decoration should conform to the shape of the object and be appropriate to its use. It should be simple and not overcrowded. The object comes first and the decoration second. We must not lose sight of the model in seeing the adornment. Simplicity and harmony are the two main principles to remember.

With reference to colour, it is best to confine young pupils to combinations of grays with spectrum colours and dominant harmonies, that is, combinations of various tints and shades of one colour.

CONSTRUCTION OF THE SQUARE

Material required: Pieces of thin cardboard to cut a 4-in. square, rulers, pencils, set-square, teacher's model, pieces of red paper.

Ask for the description and discuss how to make the shape leading up to the correct geometrical method. We are going to make a square mat or picture mount like this. Show model. What shape is it? What size is it? Measure the model and tell us. Four inches each side. What size cardboard will you need? Distribute the cardboard. Pin up the model where all the class can see it.

How must we begin? Draw a horizontal line near the bottom edge of the cardboard. This represents the lower edge of the square. On this line mark off a distance of 4 in. Why 4 in.? Because the side of the mat is 4 in. (The teacher should also draw on the black-board and go round the class quickly to see whether the pupils are working correctly.) What kind of angles must we have? Which is a right angle on your set-square? Place one edge of the set-square just touching the line, with the corner of the right angle at the point marked on the right. (Besides dictating this, the teacher should illustrate at the black-board exactly what she means.) Rule a vertical line upward. Reverse the set-square, placing the right angle at the left-hand point. Rule a line. On each of these vertical lines measure 4 in. from the bottom line and join the points. Test the angles with the set-square and the lines with the rule.

Cut out carefully. What else do we need? Two smaller squares of red paper, one for each side. What is the size of these squares? Measure and find out. Distribute red paper and allow the pupils to draw the squares as before, making them 3 in. instead of 4 in. If correct, cut. Measure and mark with a dot

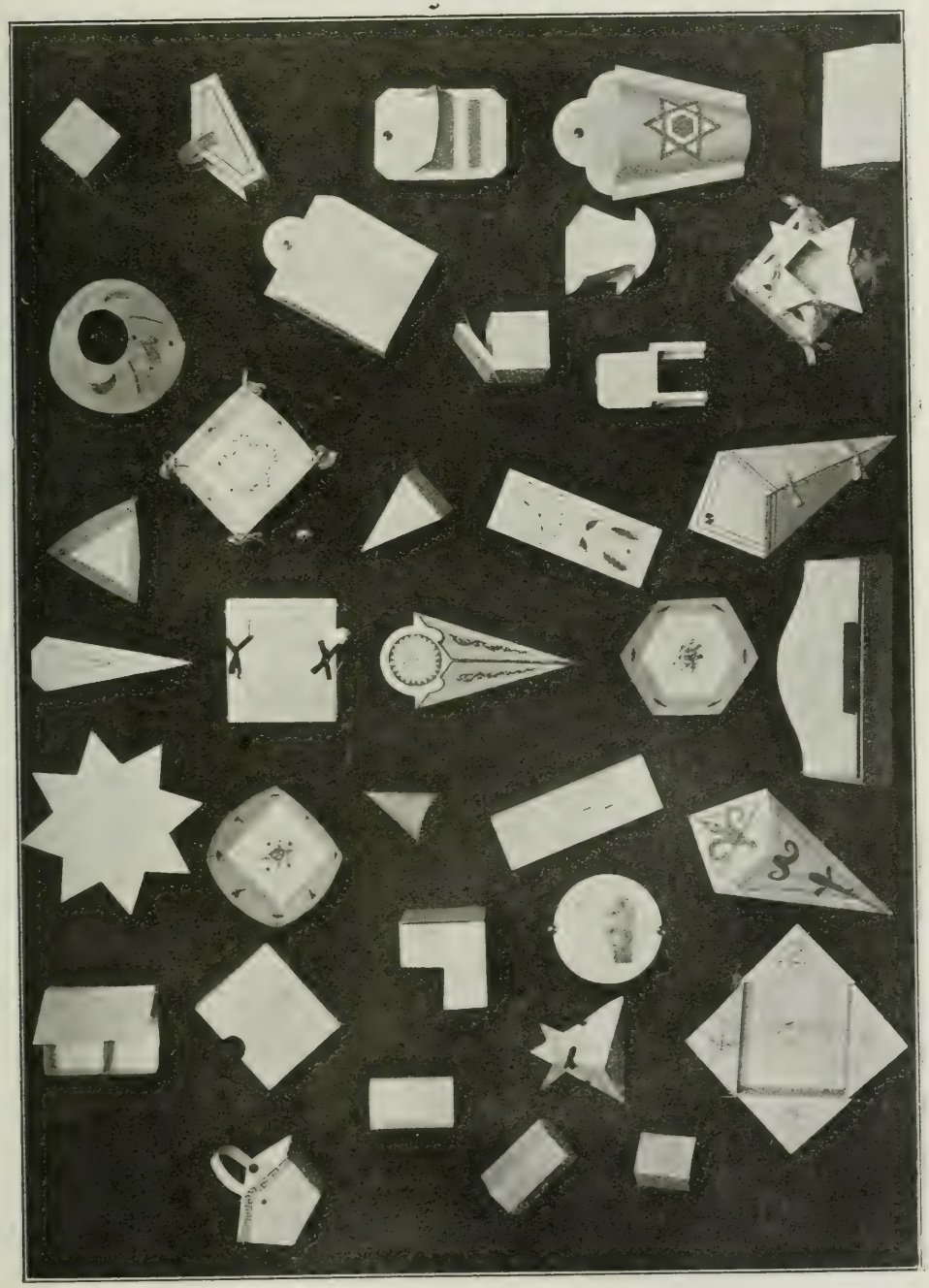


Plate 22.—Cardboard models

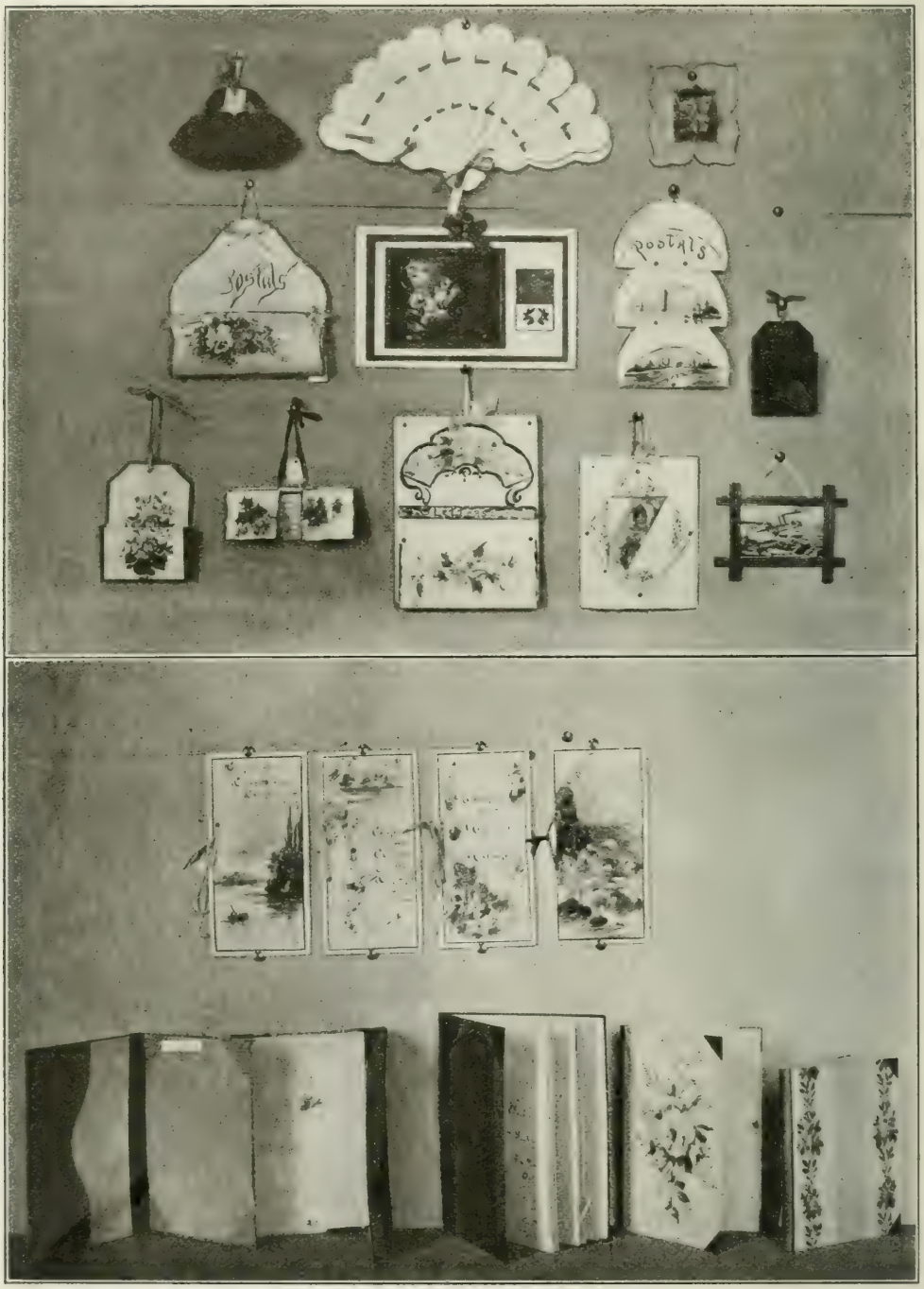


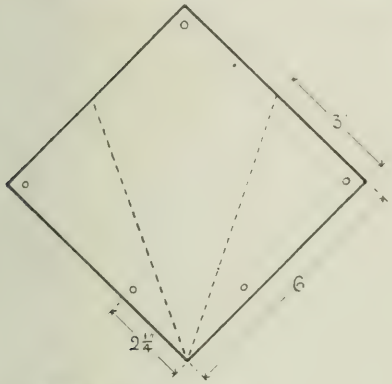
Plate 23.—Decorated cardboard models

at each corner the position of the 3-in. square on the 4-in. square. Paste the red squares and place in position.

If desired, a picture may be substituted for one of the red squares. Ask for suggestions for improving this exercise so as to make it more suitable for a picture mount or frame.

A 2-in. square of white or a tint of red may be pasted in the middle of the red square, thus forming a design for a tile. Obtain suggestions for other ways of arranging a number of squares and have some designs for tiles made. This supermounting will suggest one method of decoration.

The construction of the rectangle may be taught in the same way.



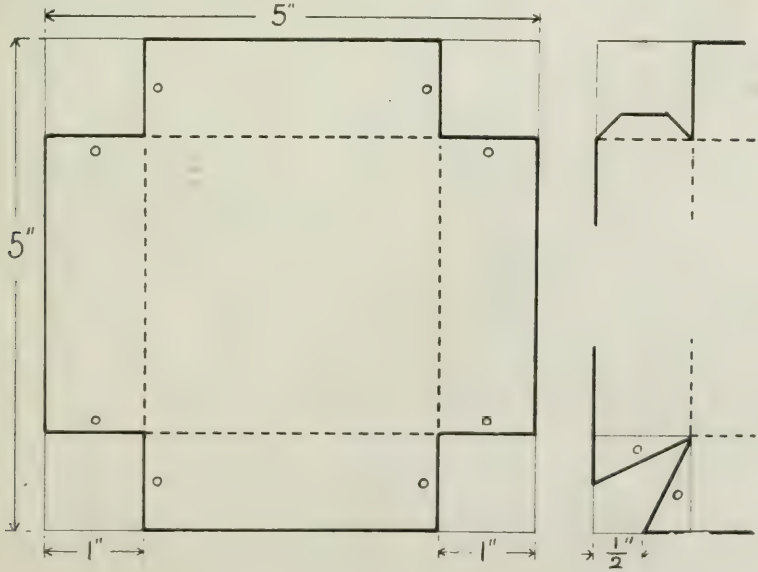
1. *Wall Pocket*:

Construct a square. Mark the middle point on two adjacent sides. From these points draw dotted lines to the opposite right angle. Score and fold. Mark where the holes for tying should be placed, measuring carefully to get them exactly opposite. Discuss briefly appropriate forms of decoration and have the model completed during a seat-work period, when necessary.

2. *Square Tray*:

The teacher should prepare one or two models before the lesson.

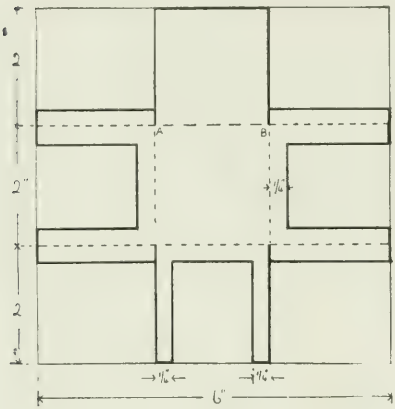
After a brief talk, one of the pupils may untie the teacher's model and tell what materials are necessary and what measurements must be known. The teacher makes the drawing on the black-board according to the pupils' instructions. Cardboard is then distributed, and they make their drawings. When these are approved, the cutting, scoring, punching, and tying are done.



After this model is made, call the pupils' attention to other objects of a similar type based on the square; for example, envelope, folded box, bed, sideboard, bureau, wall pocket, dog kennel, trough, tent, trunk, etc.

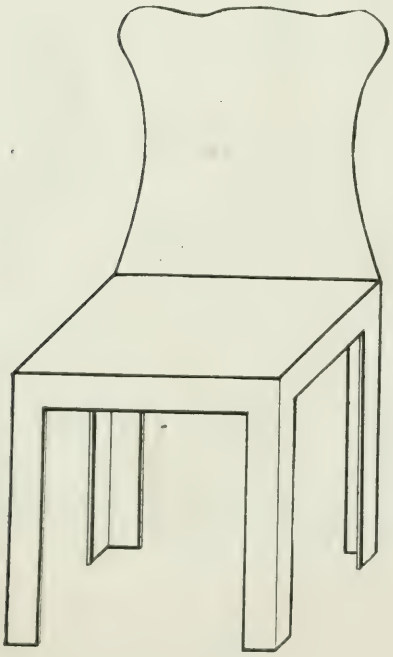
In the earlier cardboard exercises it is best to punch holes and tie the corners. Coloured string, narrow ribbon, or raffia may be used. Avoid large or numerous bows which eclipse the model. Later, provision may be made for pasting all the corners or joints, by leaving flaps or pieces for pasting as shown in the right-hand diagram.

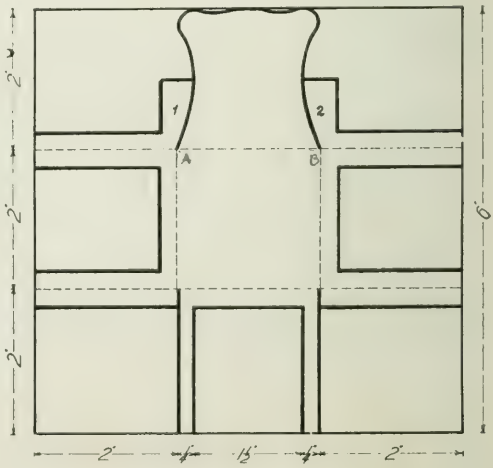
In the higher grades, where greater care and skill are demanded, the corners may be cut as for tying and then bound together by narrow strips of paper, linen, or bookbinders' cloth.

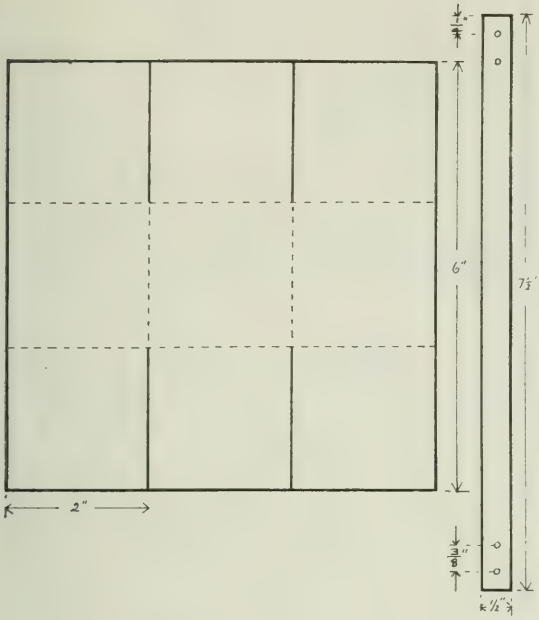


3 *Chair*:

This is similar in construction to the basket shown below. Note that the line AB must be scored on the opposite side. Allow modifications or additions as new shapes for the back—additions of arms, rockers, etc. From this pattern may be evolved other articles of furniture, such as table, settle, bureau, etc. The back may be strengthened by pasting a stout piece of paper over it and under the seat. An alternative design is given in which the back is much stronger. The flaps marked 1 and 2 are pasted behind the back, and the line AB is scored on the opposite side as before.





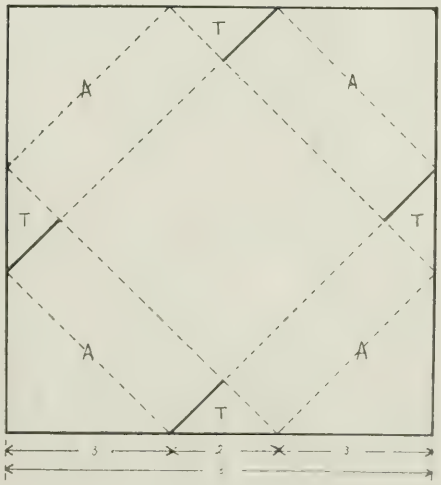


4. *Basket with Handle*:

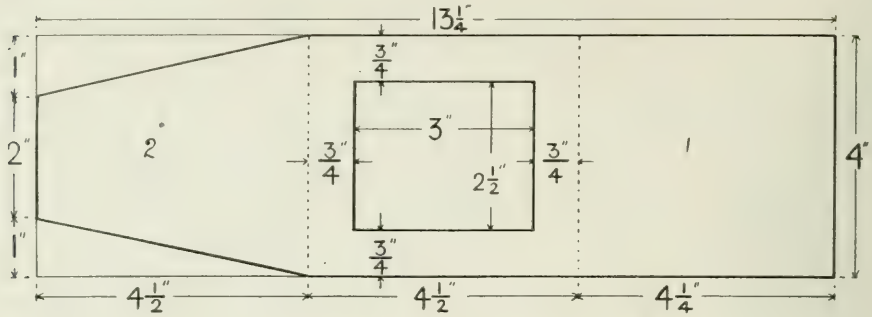
Construct a square and divide into nine equal squares. Cut and fold as indicated in the figure. Let the pupils try folding the sides into different positions and select the one which appeals to them. Punch holes in the handle. Fold the basket. Place the handle in position. Mark the place for the holes in the basket. Punch and tie or fasten with paper fasteners.

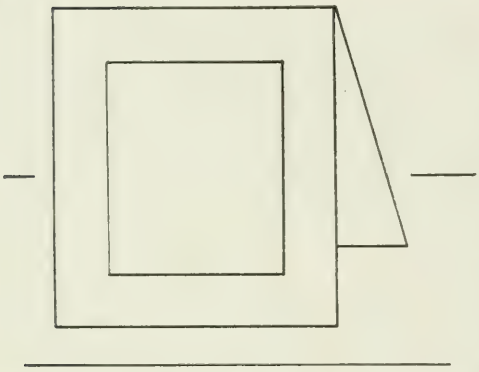
5. *Bon-bon Box*:

Note the lines marked A which have to be scored on the opposite side. Ends may be pasted, or the triangles, T, may be cut out and the ends tied. Decorate the large triangles.



6. *Picture Frame*:

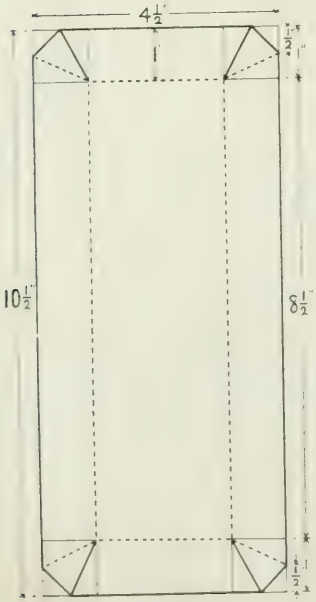




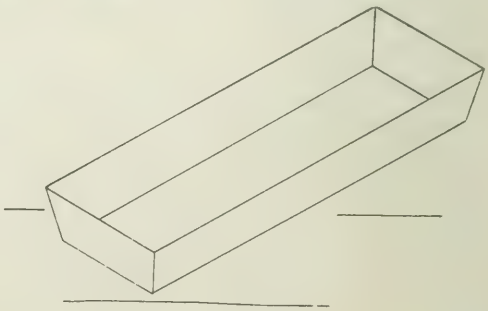
Make the drawing as shown.

To cut out the inner rectangle, draw the diagonals; where they cross, push the scissors through and cut from the centre to the corners; then cut out the rectangle, keeping the scissors and the hand under the cardboard, or cut it out with rule and knife, being careful not to cut across the corners. Number 1 is folded to form the back of the frame after the picture is inserted. Bend 2 back to form the support. The size of the opening may be modified to suit any particular picture. Either tie or paste.

7. *Pen Tray*:



Construct a rectangle 4½ in. x 10½ in. Measure one inch from each angle along the sides. Connect these points. Measure half an inch from each angle along the sides. Join these points with the angles of the inner rectangle. Cut to shape, score along the dotted lines, fold, and paste. The size will contain the average pen. This average should be obtained by allowing the pupils to measure pens of various lengths.



ILLUSTRATIVE LESSON ON A PEN TRAY

This example affords an opportunity for a variation in method. Instead of exhibiting a finished model, tell the pupils you wish them to make a pen tray. The words "pen tray" call to mind a mental picture of some object to hold pens; and by suitable questions all necessary information as to size, shape, etc., may be obtained from the pupils.

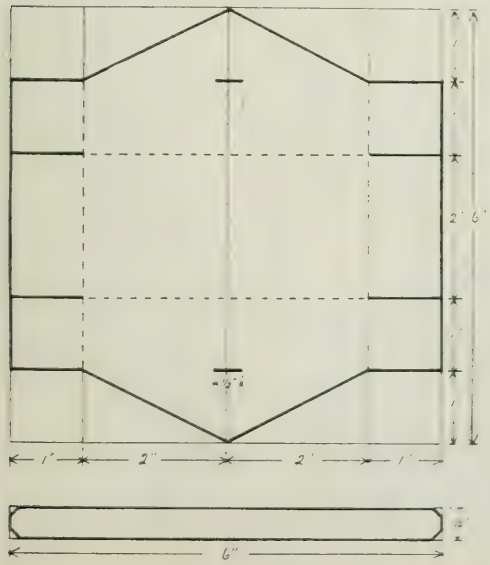
What is the first thing to decide about our pen tray? The shape. What shape do you suggest? Oblong. Why not square? Because a square tray would take up too much space on the desk, and it would also be wider than needed. How shall we decide on the length? By measuring the pens. All the pupils measure their pens. (There will be pens of various lengths, and we must take the length of new pens.) Eight inches will be a suitable length. If the pens are eight inches long, how long must we make our trays? Eight and one-half inches. Why?

Now what about the width? (Various suggestions will be made, and we must consider space available for trays on the desks, number of pens to be contained in each tray, and proportion.) A tray one inch wide would hold sufficient pens for one person. Shall we make our trays one inch wide? No. Why? The tray would look too narrow for the length. In this way discuss the various conditions, finally deciding on two and a half inches as a suitable width. This will meet all the required conditions as to size, utility, and appearance. Ask a pupil to draw a rectangle on the black-board and put in dimensions eight and a half by two and a half inches.

Now what will be the next step? Decide on the height of the sides. Before we do this, shall we have vertical or sloping sides? Sloping. Why? It will look better and be easier to take a pen out. How much must we allow for the sides? One inch all round. Ask another pupil to draw this on the black-board. How shall we have to arrange the corners in order to get the sloping sides? Draw this on the black-board.

Will it be better to tie the corners or to paste them? Paste them. Why? Because strings would look shabby and soon become untidy when the tray is being frequently handled. Suggest the best way for pasting the flaps and show exactly by means of the drawing. What decoration should we have? Nothing elaborate, but some simple form. Each pupil should plan his own decoration for his own tray. Distribute the material and leave the pupils to work out the example.

Any article having a definite use and standard size, for example, a post-card holder, may be worked out in this way. The pupils have nothing to copy from and must think and plan for themselves.



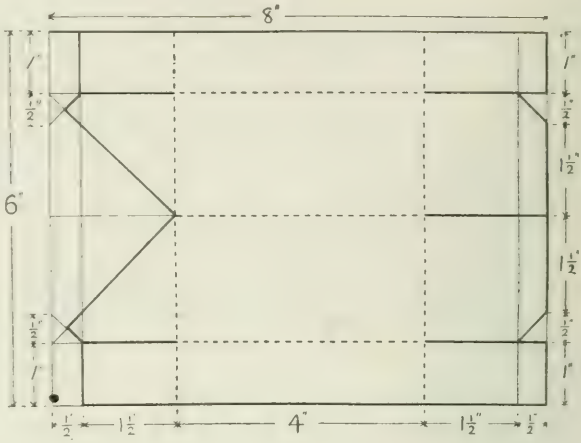
8. *Spool Basket*:

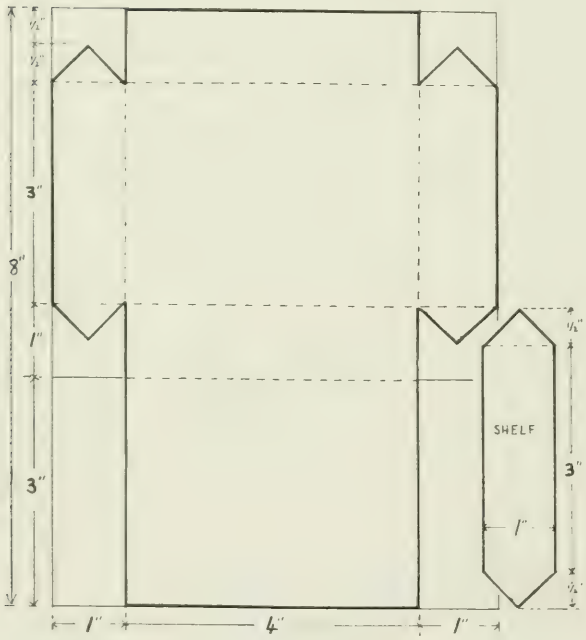
Give a brief talk on baskets, introducing local geography—from what, and how made, and for what used.

Note the drawing which is made in a 6-in. square, also the shaped ends of the handle. The short lines near the oblique lines are slits cut with the knife to receive the handle.

9. *Wall Tent*:

In drawing the ends follow the plan carefully. Note especially the parts to be cut away. Have the pupils try to invent other methods of constructing tents, Indian wigwams, Arab tents, etc.





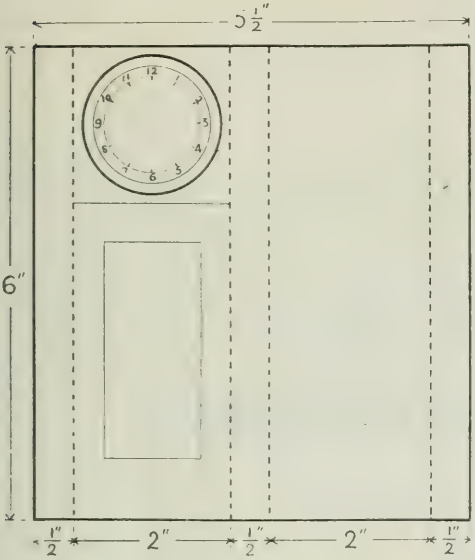
10. *Cupboard with Shelf*:

Let the pupils examine the specimen, and see that it consists of a rectangular box with a lid for the door and a cross-piece added for a shelf. In a similar way a box with any number of divisions may be made.

11. *Construction of Circle with Compasses*:

Hold the compass at the top between the forefinger and the thumb. Fix the point lightly and exactly on the required centre and practise until the compass can be revolved in a complete circle, making a line of even thickness and without enlarging the centre. The compass should be kept in an upright position. Gradually teach such terms as radius, diameter, and circumference.

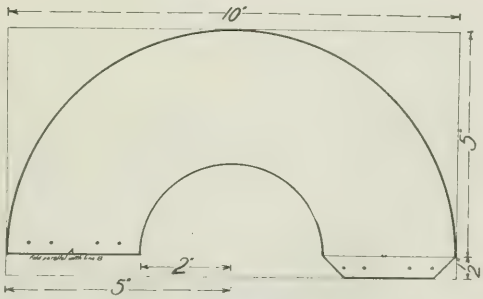
Draw and cut a circle of 3-in. diameter. Draw and cut a circle of 2-in. diameter of a harmonizing colour. Paste the smaller one in the centre of the larger one, making a small mat. Give practice in drawing various geometrical designs.



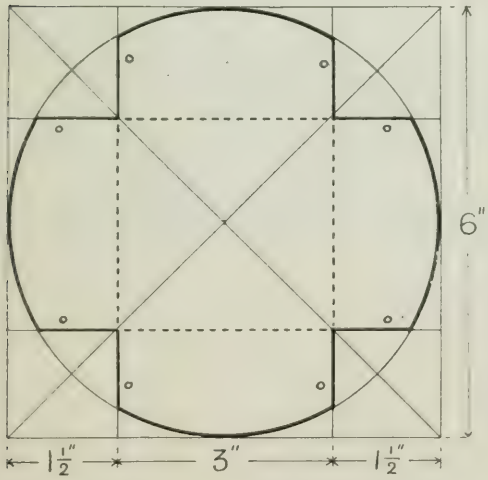
12. *Grandfather's Clock*:

To find the proper position for the figures or numerals, use very light lines and draw two concentric circles the height of the figures apart. Draw two diameters, vertical and horizontal, at right angles to each other. This will give the position of 12, 6, 3, and 9. Find the spaces for the intermediate figures by trisecting the right angles between those previously found. (See Geometrical Problem 10, page 111.)

13. *Candle Shade*:



For cutting the inner semicircle, cut along several radii and then cut the curve, having the scissors and hand under the cardboard. Punch the holes in one edge, overlap, and mark the position of the holes in the other edge. Tie or fasten with paper fasteners. Decorate, suiting the style of ornament to the shape of the object. Ask the pupils to invent a wire frame for the shade.



14. *Square Tray with Curved edges*:

Construct a square having sides 6 in. long. Draw the diagonals. Measure 1½ in. from each angle along the sides. From the centre of the square, describe a circle with a radius of 3 inches. Complete the drawing as shown. Cut, score, punch, fold, and tie. (See Geometrical Problems 16, 19, page 112.)

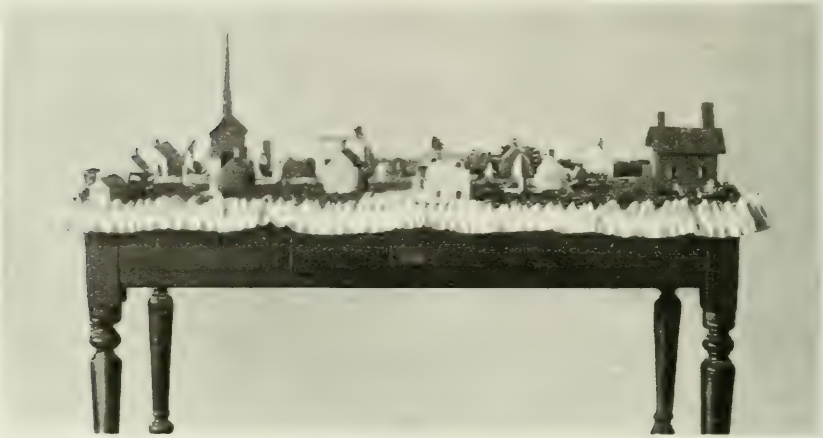


Plate 23*a*.—Community work in paper and cardboard modelling

PICTURES

One very useful form of Manual Training is collecting and mounting pictures. These will provide concrete material and teaching aids for lessons in other subjects. The pictures collected should be brought to school, sorted, and arranged in groups according to subjects; for example, those illustrating mountains form one group, those dealing with historical incidents another group, and so on; each group being kept in an envelope or portfolio made for that purpose and properly labelled. A day may be set for revising these groups, selecting from them, and arranging and mounting on sheets of cardboard. They may be kept in a case or box and are always ready for reference as required. In mounting the pictures do not crowd or duplicate. Twenty illustrations of a mountain are not needed; six will do better. If a large number be mounted on one sheet, the pupils are apt to see the whole indistinctly and not get a clear image of any one. A pupil is more likely to get a vivid impression of a sheep by looking at one, rather than at a flock of twenty. Use few pictures at a time; change them periodically; have three or four hung on the walls and encourage the pupils to study them; young pupils may tell stories about them and use them as a basis for free cutting or modelling; older ones may write compositions. When one set has been thoroughly studied, remove from the frames and replace with others.

MOUNTING PICTURES

Begin with square or rectangular pictures carefully trimmed. Use dark cardboard or heavy paper for the mount. Measure the size of the picture to be mounted and cut the mat to allow equal margins all round. Make a pencil dot where each corner of the picture is to be placed. For first mounting exercises the picture should be pasted about half an inch along the upper edge. Another method is to paste the four corners lightly. When pictures have been mounted by these methods, others may be mounted by pasting the whole of the back. After the picture has been pasted, place in position, cover with a piece of blotting or waste paper, rub down carefully, and dry under pressure.

Afterwards experiment with other pictures and mats by placing the pictures in the different positions so often seen in the designs on book covers and calendar mounts.

Sometimes a mat is built up; for example, a dark green sheet is used for the background, with white pasted over it. Leave a margin and then paste the picture on the white portion.

Many pictures look very effective when pasted on a white sheet (the white being trimmed off except a small margin) and then pasted on a dark-coloured card. Calendar mounts may be built up in this way.

FORM III

CLAY MODELLING

Continue the work as outlined in Form II. It is not necessary to enumerate a series of models, as it is impossible to draw a hard and fast line between the work of the different Forms or to grade the models according to difficulty. What is interesting to one pupil may not appeal to another. A model is often well made because the pupil likes it, whilst another is indifferently made because the pupil lacks the stimulating influence of interest.

The distinction between present and previous modelling should be one of detail, finish, and character in the completed object, rather than one of difficulty of execution.

POTTERY

Pottery may be built up, in the manner previously described, by the addition of small pieces of clay until the desired shape is obtained; but the following method, adopted by primitive races, is the one most suitable for young pupils.

The clay is made into rolls about half an inch in diameter. For a base, a roll is taken and formed into a coil. The V-shaped spaces between the coils are filled by spreading the clay, under pressure of the thumb or a flat tool, during the process of making the coil.

If the pressure is directed from the outer edge toward the centre, the original thickness can be maintained or even increased; but with the pressure in the contrary direction, the base is made larger and very much thinner. This "direction of the pressure" must be attended to throughout the work.

After showing the pupils how to make a base, let them gain skill by actual practice. Many will make the pressure stroke from the centre outward and so make their bases too thin.

Question the pupils as to the manner of getting the base back to its original size and thickness. Some will put more clay on the top of the slab and cut off the superfluous clay along the outer edge. Others will find that they can squeeze it back to its proper shape by hollowing the hands and pressing the slab on all sides at the same time; whilst others will suggest patting on the modelling board in the way familiar to them when making mud pies.

Having secured a good flat upper surface, turn the circular slab over and repeat the process until both sides are made smooth. The spaces should be well filled, and the whole slab of clay worked to an even consistency; otherwise, during the drying process, cracks will appear between the coils.

When a satisfactory base has been obtained, the pupils should be required to fix in their minds the shape of the article to be made. Carefully examine the object it is proposed to model. Where it is not possible to obtain the actual object, have the pupils make an outline sketch of the proposed model. If during the modelling the pupils wish to improve their work by changing the design, they should by all means be allowed to do so.

A reference to the photographs given of this operation will show how the size of the vessel being made may be increased or diminished by changing the position of the coil.

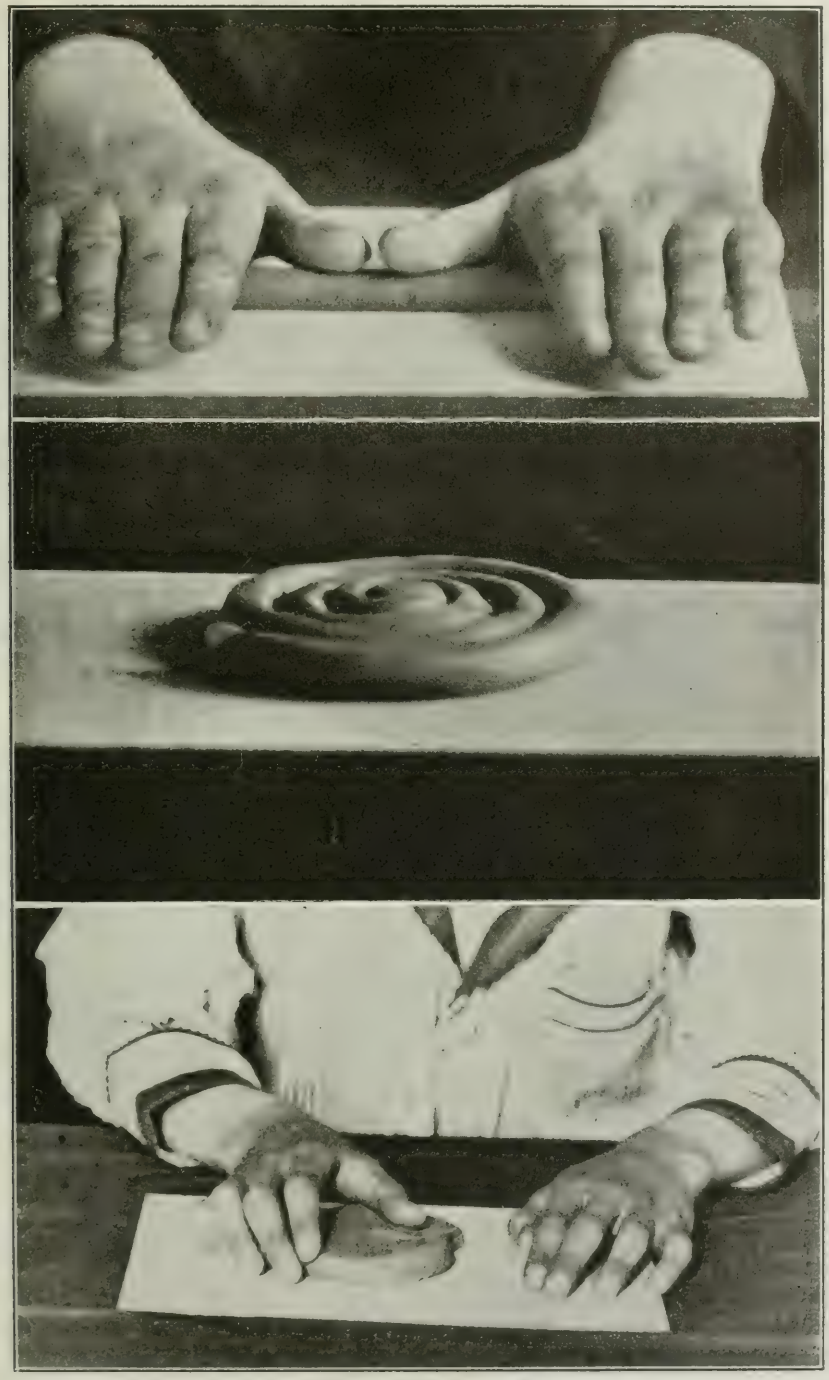


Plate 24.—Making a roll of clay to form a base 2. The coil
3. Making a base from the coil

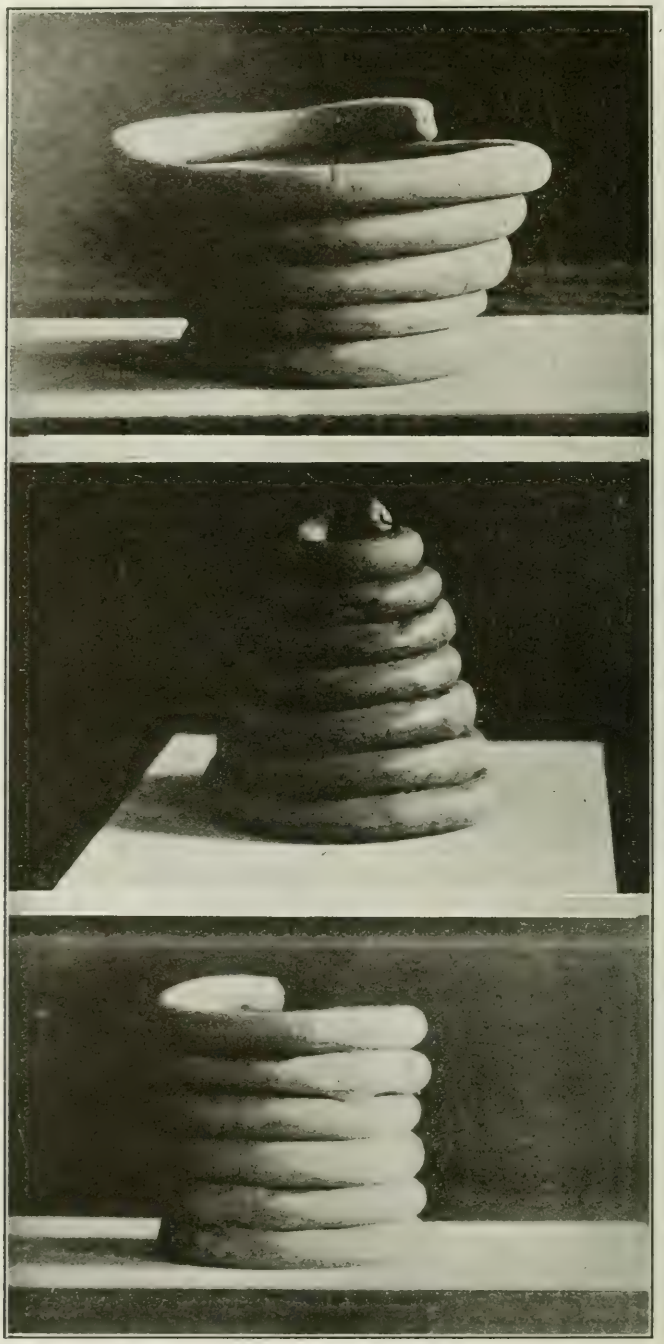


Plate 25.—(1) Increasing and (2) diminishing the sides of a vessel

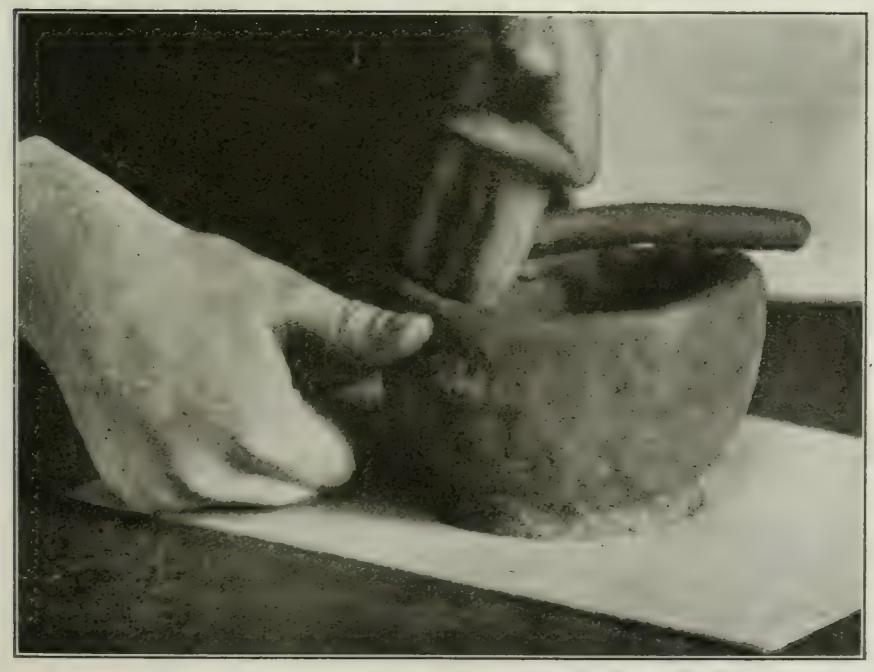


Plate 26.—Position of hands when modelling a vase

Having mastered the principle of enlarging or decreasing to make any particular shape, it would be well to draw the attention of the pupils to the difficulty that some of them had in keeping the bases the correct diameter and thickness.

Question about this and have them find out, if possible, in which direction the pressure stroke should be exerted so as to retain the proper thickness of the sides.

As the base was lying on the modelling board, when it was being pressed into shape, the pupils had the benefit of the resistance offered by the board to the pressure of the thumb. In the sides of the model there is no such resistance, and this must be furnished by the hollow hand held on the outside when modelling the inside of the subject, and by the fingers on the inside when modelling the outside. From their experience in making bases, they will probably suggest making the pressure stroke toward the base, which in a general way is correct.

Owing to lack of sufficient pressure by the hollow hand when modelling the inside, many of the pupils will make the object spread too much. To show how to correct this, let them experiment with a small piece of clay or part of a roll and try to find out how this can be made thicker and shorter. This can be done by taking one end of the small roll between the fingers and thumb of one hand and the other end between the fingers and thumb of the other hand, and gently bringing the two hands nearer to each other.

Apply this principle to those models which have become too large in circumference, taking care, however, not to spread the clay away from the base. This calls for two distinct directions of pressure—(*a*) from one hand to the other, (*b*) downward toward the base. This pressing into shape should be attended to as each coil is applied; for, if left until several rolls have been laid in position, the work will be much more difficult. The upper portion of the object can be curved as desired.

Avoid making pottery less than three eighths of an inch thick.

To give the appearance of thinness, squeeze the edge of the model between the fingers and thumb for a very short distance only, using, in addition, a pressure stroke directed from the edge of the object toward the more solid portion.

In clay modelling avoid all large pieces of thin clay, as such are likely to crack.

LEAVES AND SHELLS

In modelling thin objects from nature, such as leaves or moderately flat shells, the models should be built up bit by bit upon a slab, until the desired relief is obtained.

Begin by blocking out the shape (that is, not showing too much detail) a little smaller than that of the finished object. Build up to the required shape. To give the appearance of thinness, cut away a sufficient amount of the supporting clay. Such objects are usually modelled to be viewed from one direction, and generally speaking, the supporting clay should not be seen when so viewed. In many cases, however, it is impossible to avoid seeing some of the clay backing; for example, where the edges of leaves or flowers are doubled inward, and also in the case of the stems.

GEOGRAPHICAL FORMATIONS

Show the pupils that the outline of a map is really a portion of a plan of an object. Demonstrate this by taking any convenient object, placing it on a sheet of paper, and drawing round it with a pencil. Remove the object, and an outline plan remains.

Gradually increase the number of objects, until you get a plan of the classroom. Use strips of plasticine to represent the walls. Leave spaces for doors. Make suitably shaped blocks of plasticine to represent desks, tables, cupboards, etc. Place these in position. Draw round them. Remove the plasticine, and an outline plan remains.

Get the pupils to grasp the idea that, if they could lift up an island and put it on a piece of paper and draw round it, they would get an outline plan which is the same as the outline of a map.

Proceed a step further and develop an outline plan of the immediate district in which the school is situated, showing roads, buildings, etc. The outline so obtained is a map of the district.

Island: Begin with a well-known island. If the school is so situated that the pupils can see one from the school grounds or in some nearby pond or stream, let them model directly from this or study its shape sufficiently well to get a clear idea of it.

Give each pupil a piece of cardboard about 8 in. x 10 in. On this draw the outline of the island a little smaller than the size of the proposed model. Then take small pieces of clay and build up the general shape of the surface inside this outline. Go over it again and again until the desired shape is obtained.

In the larger islands show the course of the rivers by depressions, taking care that the course of the river has a downward trend toward its outlet. Discuss with the pupils what would take place if high land obstructed the path of the river. When the river rushes over high rocks and drops suddenly, a waterfall is formed.

Lake: Select a well-known local lake or pond, if possible. Treat it in a manner similar to that of the island, building up the model *outside* the outline. This gives greater scope for a discussion on rivers, and the action of water.

Coast Formations: Proceed, in a similar manner, to build up gulfs and bays and other coast formations. Have similar formations pointed out on the map. Let the pupils build up imaginary pieces of coast or other land formations, to represent some definite feature. This will show clearly whether they really understand the various geographical terms.

Mountains: Build up as before. Discuss the influence of mountains upon the direction of the rivers.

Cliffs: Caves and river mouths can be well demonstrated in this manner.

RELIEF MAPS

Relief maps showing the main features of a particular locality may now be attempted. Draw the outline and build up (in much lower relief) as before, showing the towns by small beads of clay or plasticine. In giving instruction on the making of relief maps, the teacher should remember the difference that must exist between the horizontal and vertical scales.

If it is desired to make permanent maps, use the special modelling material as described in the chapter on "Materials and Equipment".

One of the great advantages in using the salt and flour and paper-pulp mixtures lies in the fact that the rivers, lakes, and other waters can be coloured, as in ordinary maps, and the towns located by dots, whilst snow-capped peaks may be left white, and the remaining portion of the mountains coloured in greens and browns, etc., to represent the chief characteristics of the land. Tracts devoted to the cultivation of grain of various kinds may be coloured in some shade of orange, etc.

Plate 27.—Relief map

Plate 28.—Relief map

PAPER CUTTING

The work of Form III in this material will be a continuation and extension of that previously done. Many of the earlier problems suggested will be suitable here also, but greater attention should be given to detail, character, and arrangement. The powers of execution and observation hitherto developed will lead to more accurate and artistic results. The units used may be smaller and should be more largely employed for purposes of decoration and design.

Many of the cardboard models hereafter described may be appropriately decorated with paper cuttings of various kinds. The conceptions formed of the significance of special days and seasons, historical incidents, and geographical facts, will differ materially from those formed at an earlier stage and will be expressed in more elaborate and detailed cuttings. At this stage much greater use should be made of coloured paper—radial border and all-over patterns may be effectively designed. By the use of different colours it is possible to produce pleasing pictorial compositions in flat colour tones. Suitable subjects for this work are simple landscapes and seascapes, feast of lanterns, maps, stories. In fact, practically all the suggestions previously given can be worked out in coloured paper. As an illustration of this, take the "feast of lanterns" made at Hallowe'en. This may consist of a fence (medium gray green), grass (dark green gray), background of black paper, and lanterns (orange-yellow), with eyes, nose, and mouth openings filled with light yellow.

Attention should be paid to the general arrangement, in order to secure a pleasing composition. The centre post of the fence should be well to the right or left of the centre of the picture. Place the pumpkins in different positions, and see that the grass occupies less than one third of the picture space, in order to give room for the fence with its lanterns.

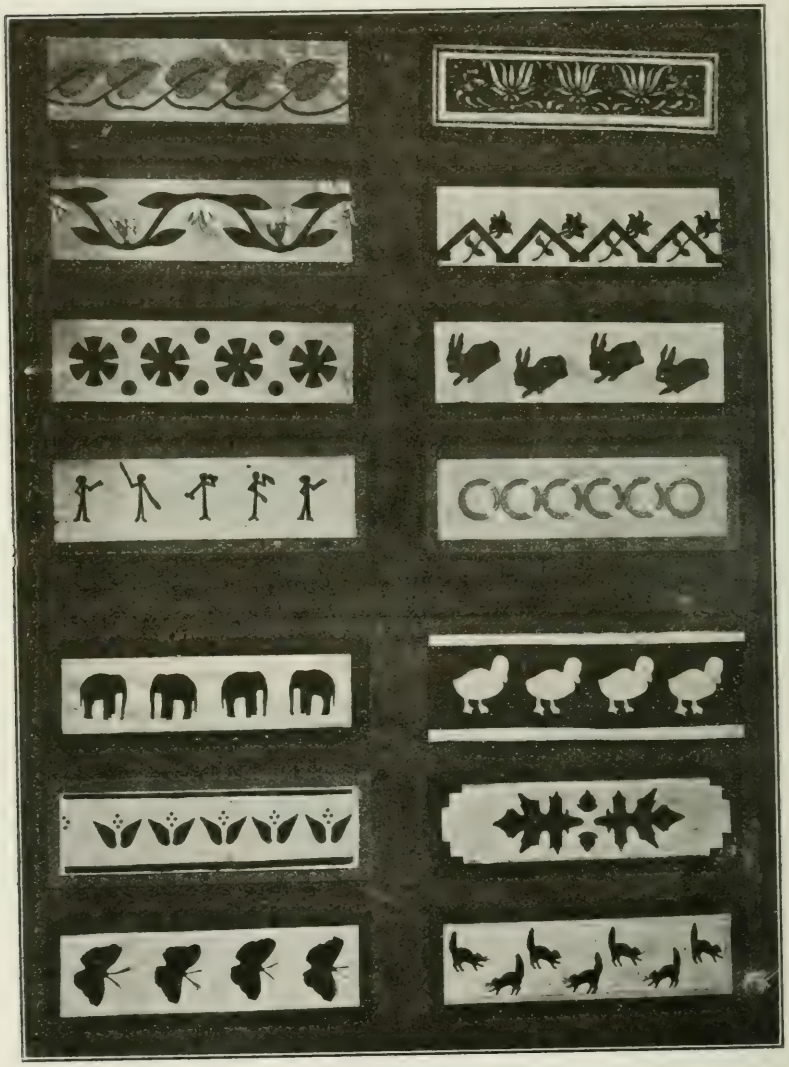


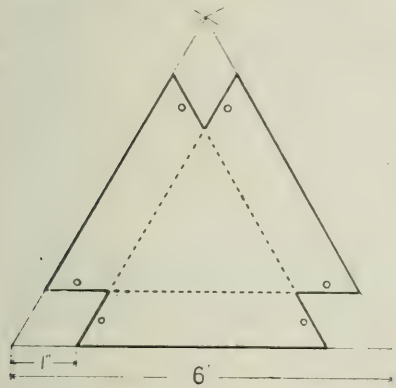
Plate 29.—Paper cuttings used for designing borders

CARDBOARD CONSTRUCTION

CONSTRUCTION OF THE TRIANGLE

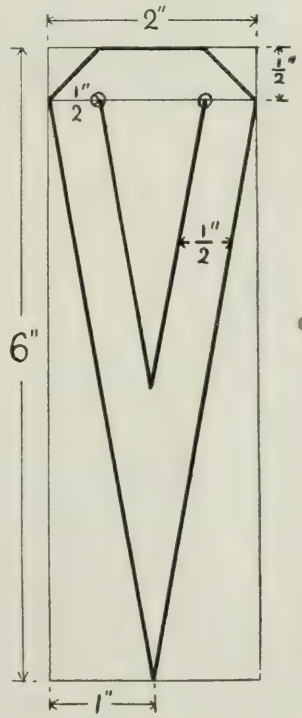
The previous lessons in paper folding have included the formation of the common triangles. These should now be used in reviewing what has been learned about the triangle.

The geometrical constructions of the various figures required in the making of the following models are given in the geometrical problems outlined for this Form.



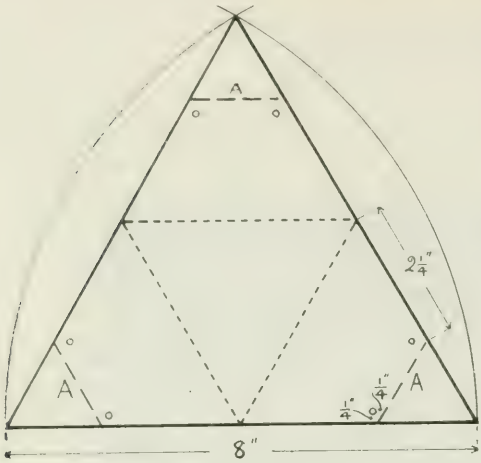
1. *Triangular Tray*:

Construct an equilateral triangle of a given size. Complete the figure according to the drawing. Cut out corners. Punch holes, score, fold, and tie. Review methods of fastening corners. (Geometrical Problem 13, page 111.)



2. *Book Mark*:

Construct a rectangle 2 in. x 6 in. Make drawing as shown, noting parallel lines. Punch holes and cut along heavy lines. The top may be modified in various ways. Several such modifications are shown. (Geometrical Problem 14, page 112.)



3. *Triangular Candy Box*:

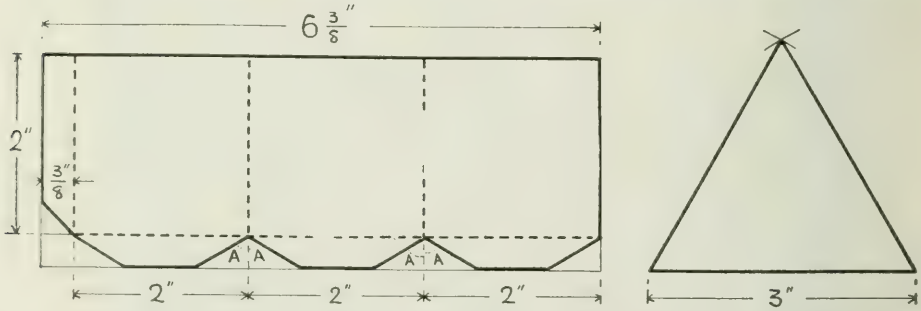
Construct an equilateral triangle of 8-in. sides. Find centre of each side. Join these points. Draw remaining lines according to measurements given. Punch holes. Fold and tie.

Lines marked A should be scored on the opposite side.

(Geometrical Problems 4 and 13, pages 109, 111.)

4. *Toothpick Holder*:

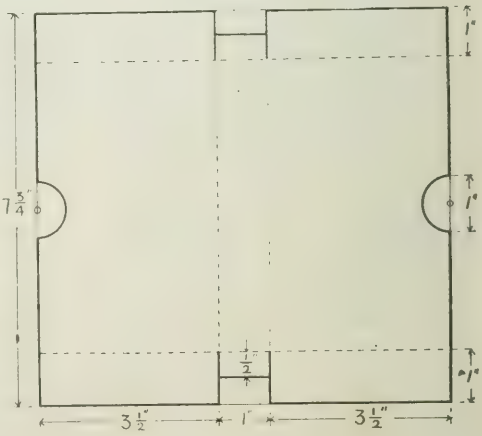
Construct an equilateral triangle on a 3-in. base. Construct a rectangle 2⅜ in. x 6⅜ in. Score, and fold to shape by pasting the flap on the short side of the rectangle. Paste remaining flaps and fix to base. Hold flaps in position

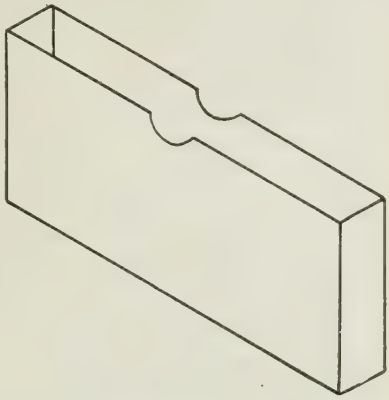


from the inside until the paste is set. The angles at A must be slightly more than 60 degrees, otherwise the flaps will overlap. (Geometrical Problems 12, 13, 17, pages 111, 112.)

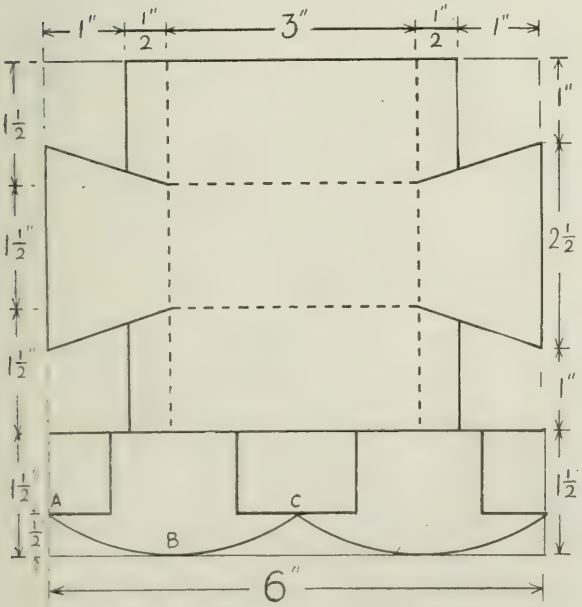
5. *Post-card Holder*:

This object, like others that are for a particular, definite use, may be taught inductively. Do not exhibit the specimen model. Suggest to the class that a post-card holder be made to contain picture post-cards that are worth keeping. Question as to size and shape of post-cards and from the answers decide that a rectangular holder will be satisfactory. Make a sketch on the black-board of such a holder. Now decide the size and draw out the stretch-out plan. What will



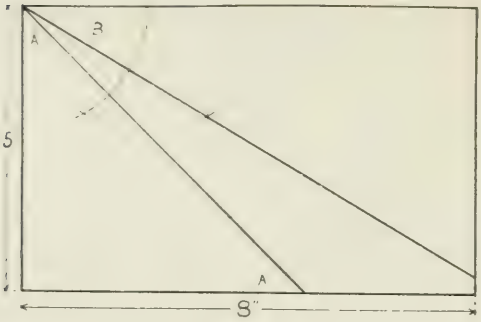


determine the size? The length and width of the cards. How shall we decide the width of the box? We do not need a very wide one. One half an inch wide would hold quite a number of cards, but the base would be so narrow that the box would not stand up. One inch may be a satisfactory width. If not we will make a wider one some day. How can we make it a little easier to withdraw the cards? By cutting curves or triangular pieces out of the top edges. Now what about decoration? A couple of picture cards cut to fit with a border of ¼ in. or ½ in. all around, would be suitable. Shall we decorate the ends? Yes, if we can find a picture of, or make a sketch of a tree, to form narrow panels for the ends. As the lesson proceeds, the plan on the blackboard will be completed, and the pupils may now be left to work out the exercise. The small semicircles may be drawn with compasses or a coin or disc may be used as a templet.



6. *Cradle*:

Construct a 6-in. square. Divide into four equal rectangles. Complete the drawing. The design of the ends may be modified by the pupils. To obtain the curves for the rockers, draw curves to pass through the points A B and C. Apply Geometrical Problem 18, page 113. Finish the model as previously described.

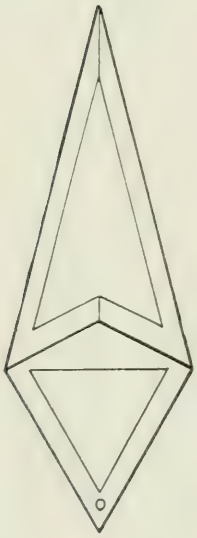


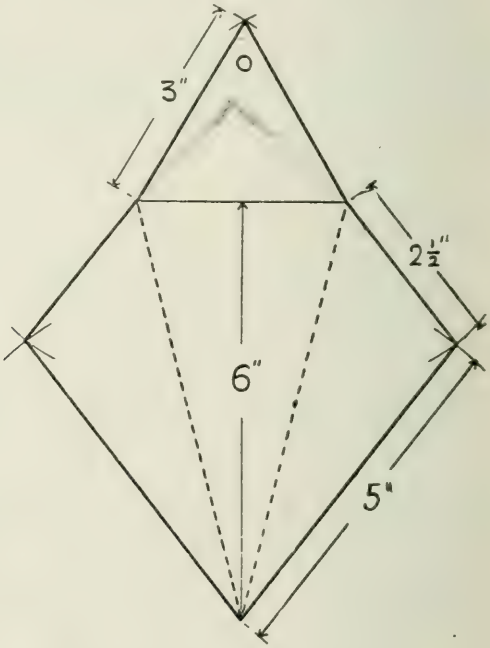
7. *Pair of Set-squares or Triangles*:

Construct a rectangle 5 in. x 8 in. The angles at A are 45° and the angle at B 30°. Draw lines as shown and cut out the two triangles. Mark the size of each angle of each triangle in degrees. Holes may be punched in each triangle for hanging up if desired. (Geometrical problems 9, 12, page 111.)

8. *Triangular Wall Pocket*:

This is an exercise on the formation of three different kinds of triangles—equilateral, isosceles, and scalene. The model is finished in the usual way, or as in the sketch, by panels of coloured paper. (Geometrical Problems 13, 14, 15, pages 111, 112.)



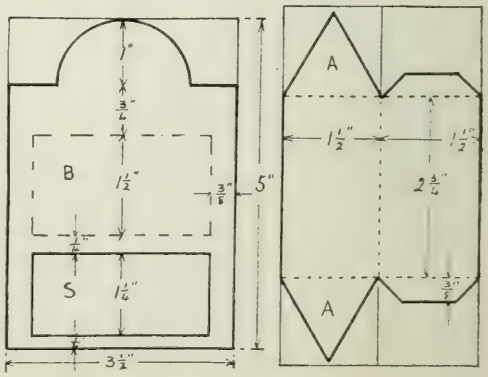


9. *Match Box*:

For the back construct a rectangle 3½ in. x 5 in. S represents sand-paper, B the space the box is to occupy. A design for the top is suggested.

For the box construct a rectangle 2¾ in. x 3 in. Construct equilateral triangles, A, and draw the pasting flaps.

Boxes of other shapes may be designed.

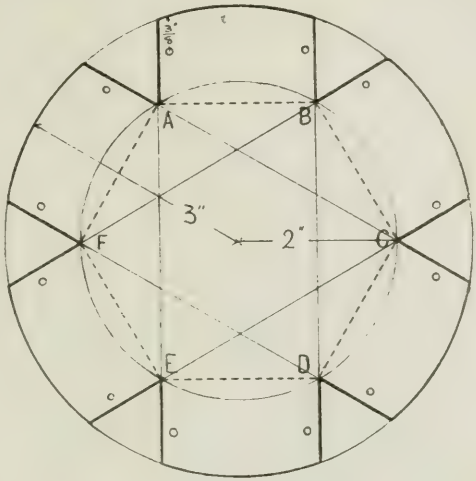


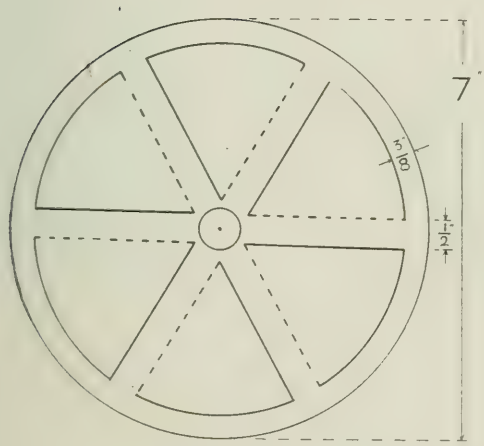
10. *Hexagonal Tray*:

Describe two concentric circles of 2 in. and 3-in. radius respectively. In the smaller circle inscribe a hexagon.

From the circumference of the larger circle draw lines through points AC, BD, CE, DF, EA, FB.

Cut, punch holes, score, fold, and tie. (Geometrical Problem 23, page 114.)





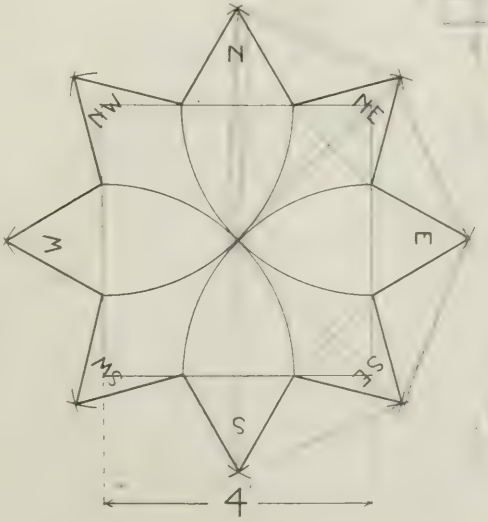
11. *Windmill*:

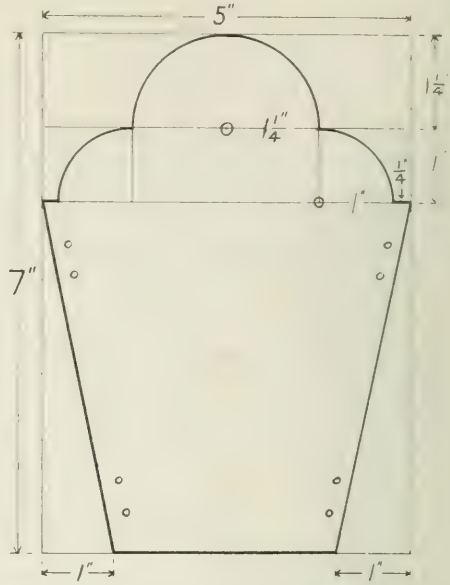
Draw the two larger circles as shown. Divide the circumference of the inner one into six equal parts. On each side of each of the six points measure ¼ inch, to give the six half-inch spokes. Cut on the heavy lines and bend the triangular pieces out a little way. The centre circle is a disc used as a washer. Attach to a stick and see the windmill work. If wheels for a cart are desired, draw smaller circles and cut out the triangular pieces.

12. *Compass Card*:

Construct a square with 4-in. sides. Inscribe a regular octagon. (Geometrical Problem 26, page 114.)

On each side of the octagon describe an equilateral triangle. Mark the points of the compass in each angle of the completed figure after cutting out. Study the action of the compass.



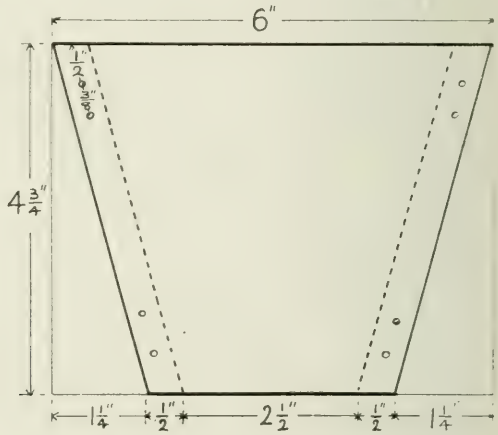


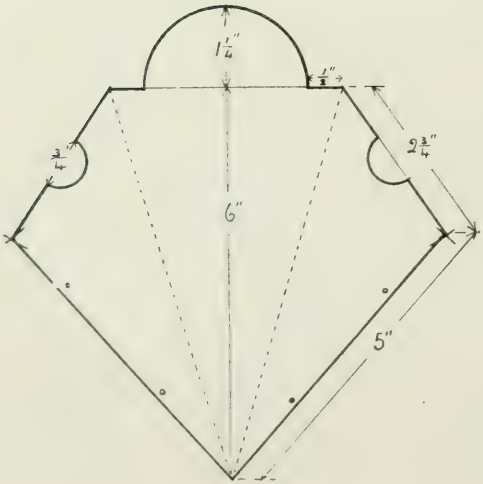
13. *Whisk Holder*:

The back is formed in a rectangle 5 in. x 7 in., and the front in one 4¾ in. x 6 in.

Allow original designs to be made for the top. The front may be appropriately decorated either with water-colours or cut out paper designs.

Note that the front is wider than the back. Why?



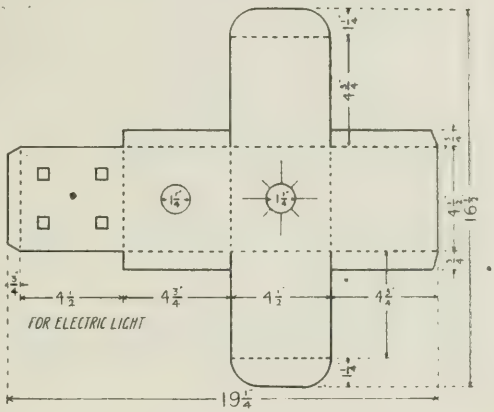


14. *Wall Pocket*:

A model of this type has been given previously, but the design shown here is more elaborate and requires greater care in construction. Decorate as desired.

The exercises in construction given above should be regarded as types only. Each one admits of many modifications both in design and size according to the purposes it is intended to fulfil. For example, if the whisk possessed by one pupil differs in size from that possessed by another, the holder made should also differ in size.

15. *Egg-candling Apparatus—(for Electric Light)*:

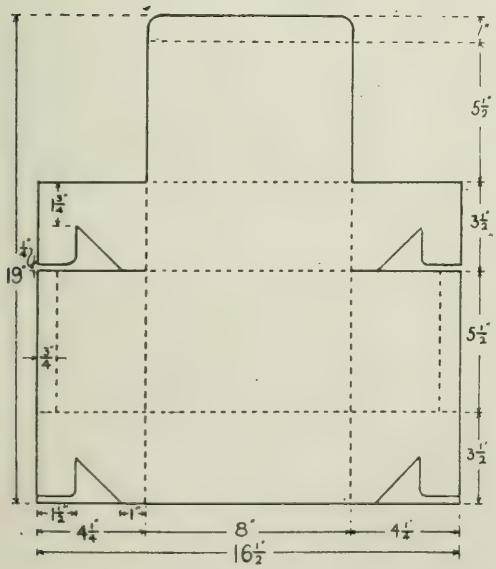


Make the drawing as shown. Cut on all heavy lines. Fold on dotted lines. Slip the bulb through the hole opposite the four small holes and fit the box as tightly as possible around the socket of the lamp.

When candling, hold the egg with the large end uppermost. Place the egg close to the hole through which the light comes and turn it around slowly.

A new-laid egg should appear quite clear except for a slight clouded effect in the centre caused by the yolk; a stale egg may be detected by the size of the air cell, and a bad egg appears quite dark and opaque when passed before the light.

This appliance may be obtained free upon application to the Live Stock Commissioner, Ottawa, but it forms a useful exercise and is not difficult to make.

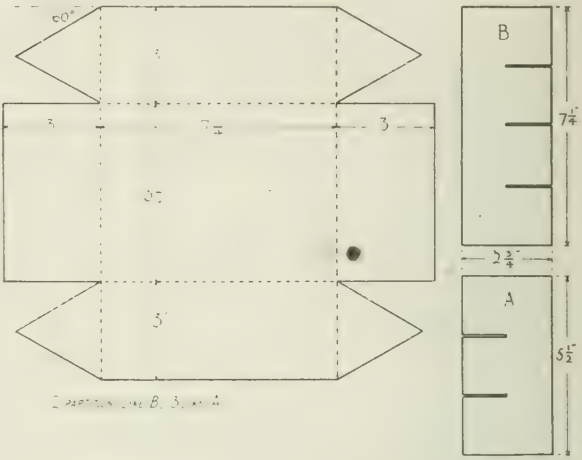


16. *Lunch Box*:

This box is large enough to contain a very satisfactory lunch. Draw and cut as directed in previous models.

17. *Egg Box*:

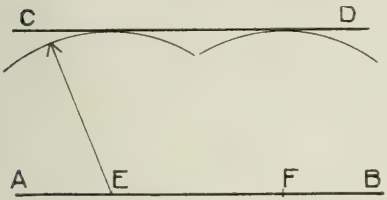
This box will hold one dozen eggs. It should be made of fairly stiff cardboard. The width of the slots in the partitions is equal to the thickness of the material used. A lid may be added. The lunch box construction may also be used by changing the size and adding partitions.



MECHANICAL DRAWING

GEOMETRICAL PROBLEMS

A series of basic geometric problems is given, as all the constructive work in cardboard and in wood and all mechanical and working drawings depend upon such problems. In every problem presented, the teacher is advised to stress the geometrical principles involved. Correct working methods at this stage will do much to secure accurate and finished workmanship in all future operations.



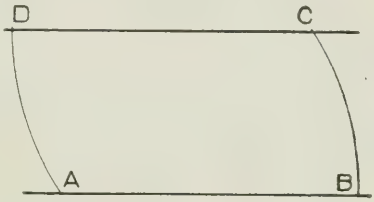
1. *To draw a line parallel to a given line AB*:

Take any two points E and F on the given line AB. Describe arcs at the required distance.

Draw line CD tangential to these arcs.

CD is parallel to AB and is drawn at the required distance from AB.

2. *To draw a parallel line through any given point*:

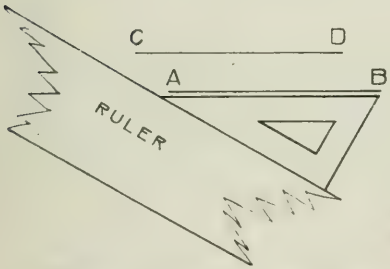


Let AB be the given line and C the given point. With C as centre, and any convenient radius, describe arc AD.

With A as centre, and with the same radius, describe arc CB.

Make AD equal to CB. Draw a line through points CD.

CD is parallel to AB and passes through the given point.

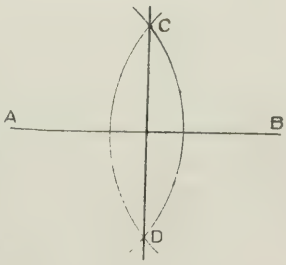


3. *Mechanical method of drawing lines parallel to other lines*:

Place the ruler and set-square in such a position that one edge of the set-square is on the given line, then slide the set-square along the edge of the ruler to the required point through which the parallel line is to be drawn, as at CD.

NOTE:—A similar result may be obtained by using two set-squares.

4. *To bisect a line and also to draw a line perpendicular to another line, through its middle point.*



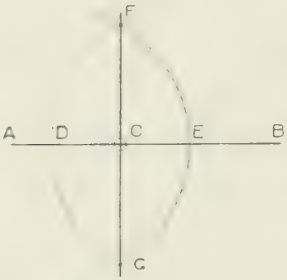
Let AB be the given line.

With A as centre, and any radius over half the length of the line, describe an arc.

With B as centre, and the same radius, describe another arc intersecting the previous one in C and D.

Draw a line through points C and D.

The line CD bisects AB and is also at right angles to it.



5. *To draw a line perpendicular to another at any given point:*

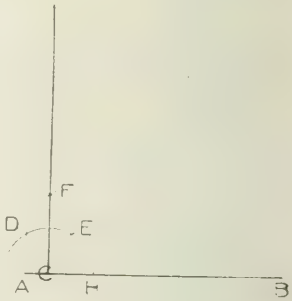
Let AB be the given line and C the given point.

With C as centre, and any convenient radius, mark the points D and E.

With D as centre, and radius DE, describe the arc GEF, and with E as centre, and the same radius, describe the arc GDF.

Draw the line FG through the points of intersection.

6. *To draw a line perpendicular to another when the point is at or near the end of the given line:*

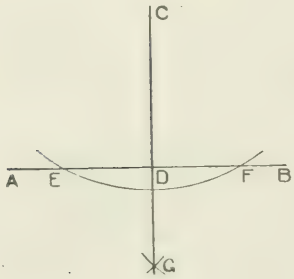


Let AB be the given line and C the given point.

With C as centre, and any radius, describe an arc.

From H with the same radius, mark off points E and D.

With E and D as centres, and any radius, draw arcs intersecting at F. Draw a line from C through F. FC is perpendicular to AB.

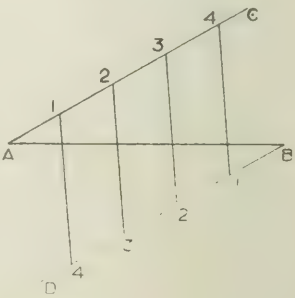


7. *To draw a line perpendicular to a given line from a point without the line.*

Let AB be the given line and C the given point.

With C as centre, and any radius greater than CD, draw an arc cutting the line AB in E and F; from these points as centres, with any radius, describe arcs intersecting at G; from C draw a line through G. CG is perpendicular to AB.

8. *To divide a line into any number of equal parts.*

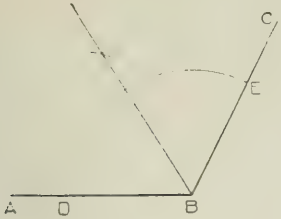


Let AB be the given line to be divided into, say, five equal parts. From one end A, draw a line AC at any convenient angle to AB, and from B draw BD at the same angle. (AC will be parallel to BD.)

From A on the line AC mark off *four* equal divisions (that is, *one less* than the required number of equal divisions of the line AB), and from B on the line BD mark off the same four divisions.

Join 4 to 1, 3 to 2, 2 to 3, and 1 to 4.

This will divide AB into the required five parts.



9. *To bisect any angle, say, the angle ABC:*

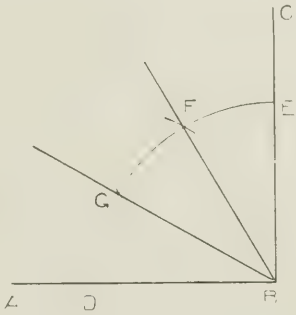
From B as centre, and with any radius, draw the arc DE; and from D and E as centres, with any radius, draw arcs intersecting at F; join BF, which will bisect the angle ABC.

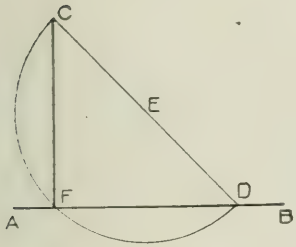
10. *To trisect a right angle, ABC:*

With B as centre, and any radius, describe an arc DE; with the same radius, and D as centre, set off a point F; join FB. Note that BF makes 60 degrees with AB, and 30 degrees with CB.

With E as centre, and with the same radius, set off a point G; join GB.

GB and FB will trisect the right angle ABC.





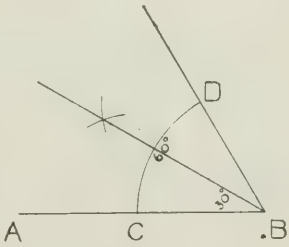
11. *To draw a line at right angles to AB from a point C nearly opposite one end of the line:*

Take any point D, not opposite to C, on the line AB; join CD and bisect it in E; with E as centre, and EC as radius, describe the semicircle CFD, and join CF. CF will be at right angles to AB.

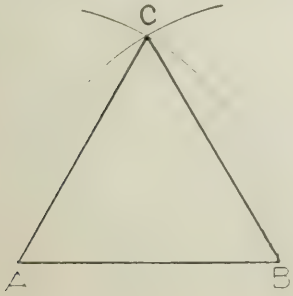
12. *To construct angles of 60 degrees and 30 degrees:*

At one end of a line AB, and with any radius, describe an arc CD; and from the point C with the same radius, set off a point D; join DB, which will make 60 degrees with AB.

Bisect this angle and the required angle of 30 degrees will be obtained.



NOTE:—If, in the first part of this problem, the arc be extended and two divisions of the radius marked off, an angle of 120 degrees will be obtained.

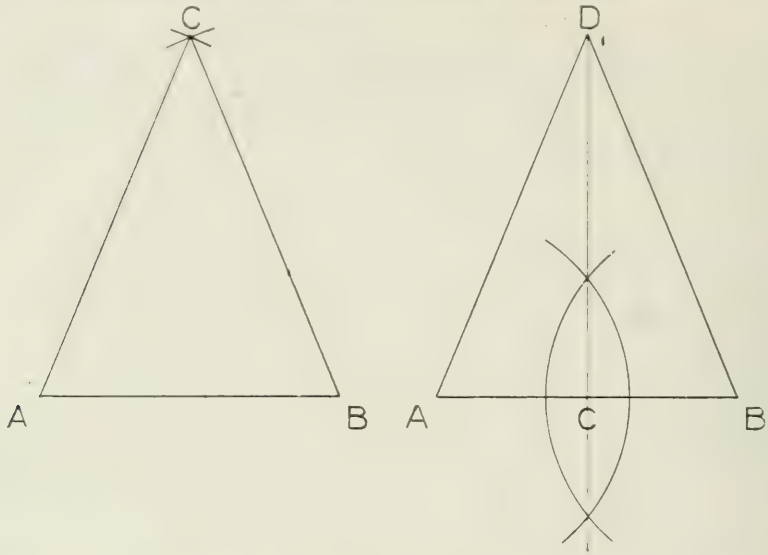


13. *To construct an equilateral triangle on base AB:*

From each end of the line AB, with A and B as centres, and with radius AB, describe arcs intersecting at C; join CA and CB.

ABC is the required equilateral triangle.

14. *To construct an isosceles triangle upon a given base AB:*

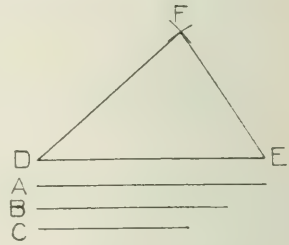


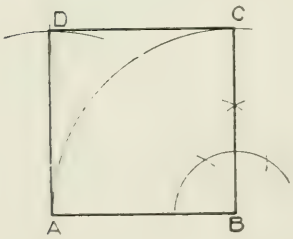
Bisect AB in point C. From C erect a perpendicular CD (equal to the height of triangle required). Join AD and DB.

With A and B as centres, and the length of side required as radius, draw arcs intersecting at C; join AC and BC.

15. *To construct a scalene triangle with sides equal to A, B, and C, respectively.*

Make DE equal to A.
From points D and E respectively, with radii equal to B and C, draw arcs intersecting at point F.
Join DF and EF.





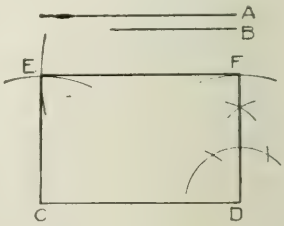
16. *To construct a square on a given line AB:*

At point B erect BC perpendicular to AB and equal to it.

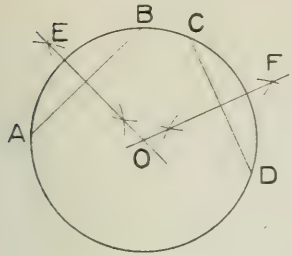
With A and C as centres, and radius equal to AB, draw arcs intersecting at D.

Join DC and DA. ABCD is the square required.

17. *To construct a rectangle with sides equal to A and B:*

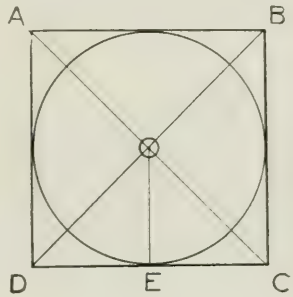


Draw the line CD equal to the given line A. At D erect a perpendicular DF equal to the given line B. With C as centre, and radius equal to the line B, and with F as centre, and radius equal to the line A, draw arcs intersecting each other at E; join EC and EF, which will give the rectangle required.



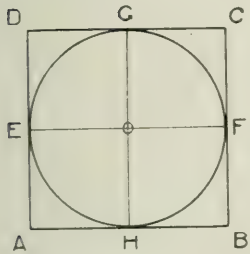
18. *To find the centre of a circle*:

Draw any two chords as AB, CD.
Bisect these chords and produce the bisecting lines until they meet at the point O.
Then the point O is the required centre.



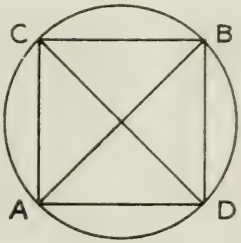
19. *To inscribe a circle in a given square*:

Let ABCD be the given square.
Draw diagonals AC and BD. The point of intersection, O, will be the centre, and OE the radius of the circle required.



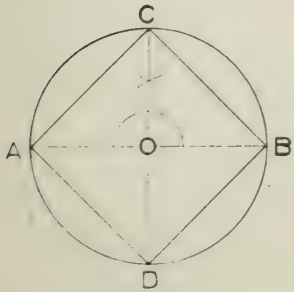
20. *To circumscribe a square about a given circle*:

Find the centre of the circle.
Through the centre draw diameters at right angles to each other. Through the ends of these diameters draw lines at right angles to them. The resulting figure is the square required.



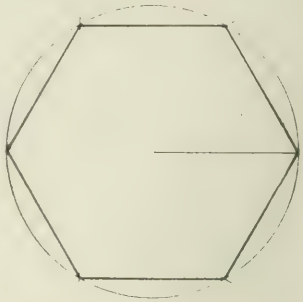
21. *To inscribe a square in a given circle*:

Draw any two diameters at right angles to each other. Join the ends of these diameters.
ACBD is the square required.



22. *To describe a circle about a given square*:

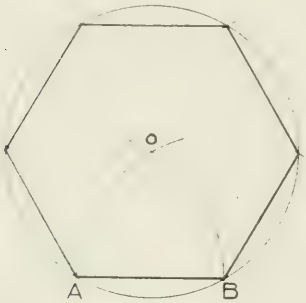
Draw diagonals AB and CD intersecting at O.
With OB as radius, describe the required circle.



23. *To describe a regular hexagon in a given circle.*

Find the centre of the circle and mark off the radius six times on the circumference.

Join the points, and the figure will be the required hexagon.

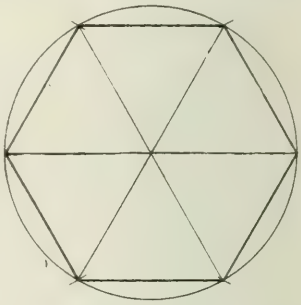


24. *To describe a regular hexagon on a given line AB.*

With A and B as centres, and AB as radius, describe arcs intersecting in O.

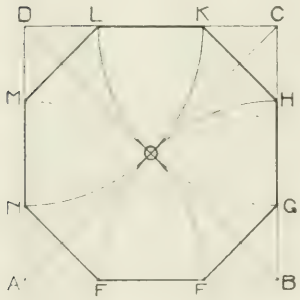
O is the centre of the containing circle. With O as centre, and OB as radius, describe the circle and set off the radius six times on this circle.

Join the points and obtain the required hexagon.



25. This figure is composed of six equal triangles all equilateral and equiangular.

Thus all the lines are equal to each other and all the angles are also equal to each other.



26. *To inscribe a regular octagon in a given square.*

Let ABCD be the given square.

Draw diagonals AC and BD intersecting in O.

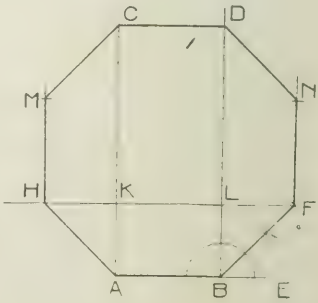
From A, B, C, and D, as centres, and AO as radius, describe the arcs FOM, EOH, GOL, and KON.

Join EN, ML, KH, and GF, and the required octagon will be obtained.

27. *To describe a regular octagon on a given line AB.*

Let AB be the given line.

At A and B erect perpendiculars AC and BD. Produce AB to E. Bisect the angle DBE by the line BF. Make BF equal to AB. From F draw the line FH parallel to AB and make KH equal to LF. Join AH. Set off on AC and BD, from the points A and B, a length equal to HF, and this will give the points C and D. With the points C, D, H, and F, as centres, and a radius equal to AB, draw arcs intersecting at M and N. Join HM, MC, CD, DN, NF. This will give the required octagon.



SCALE DRAWING

When large objects, buildings, etc., are to be represented on paper by drawings, it is obvious that the dimensions must be reduced proportionately, in order that the details required may be reproduced on paper of convenient size. For this purpose we use a *scale.*

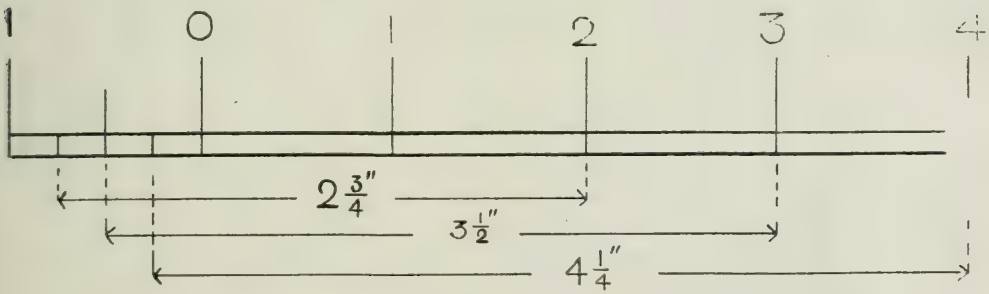
When the object is small enough it is drawn full size; the larger the object, the greater the reduction in the size of the drawing.

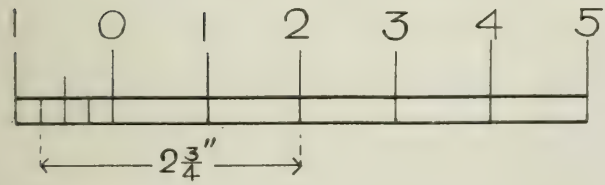
The scales to be used in this Form will be: Full Scale, Half Scale, and Quarter Scale.

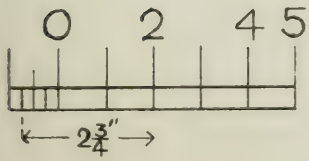
FULL SCALE

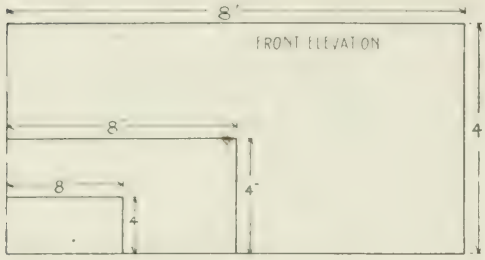
Take some simple object; for example, a chalk box, and let the pupils measure one side only at this stage. Suppose the front of the box measures 4 in. x 8 in.

A pupil measures the lower edge of the box and finds it to be 8 in. All the pupils then draw lines 8 in. long near the lower edge of their papers. Another pupil measures the height and finds it to be 4 in. What kind of angles has the box? Right angles. Erect perpendiculars 4 in. long at each end of the line. Join the upper ends of these.









This gives a rectangle exactly the size of the side of the box chosen, and, being a drawing of the front, is called a Front View, or Front Elevation. Print this in some convenient place. Draw dimension lines as shown and attach the figures 4 in. and 8 in. respectively.

HALF SCALE

This means that every line in the drawing will be half the true length of the side which it represents; for example, a half inch to one inch.

How long is the lower edge of the box? 8 in. What should be the length of the line to represent this? 4 in. What dimension must we place to this line? 8 in. Why? Because it represents an object which is 8 in. long.

Deal with the vertical lines in the same way. Print the title as before.

QUARTER SCALE

Take the same object and treat it in the manner described for the Half Scale. Every line drawn will be one quarter of the actual dimension. Print the title.

Very small objects often require enlarged drawings to show their parts clearly. As an example, take some small object in paper which the pupils have made, and draw it to the following scales:

1 in. to ½ in., that is, twice the size of the object.

1 in. to ¼ in., that is, four times the size of the object.

Show the class how to construct and use a scale showing ¼ in.

Draw a line 6 in. long. Mark off the inches and erect perpendiculars ½ in. long at each division. Complete the scale.

The division on the left is the only one subdivided. Find the half-inch mark in this and erect a perpendicular ⅜ in. long. Draw another 6-in. line ⅛ in. above the first one. Divide the first inch into quarters and erect perpendiculars.

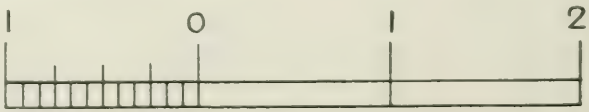
To measure 3½ in. by means of this scale, measure from the figure 3 back to the ½-in. division.

To measure 4¼ in., measure from the figure 4 back to the ¼-in. division, and so on.

We can use the above scale when drawing to the scale of $\frac{1}{12}$, or 1 inch to one foot. Each one-inch division will then represent one foot and will be so denominated. The divisions in the left-hand space will each represent ¼ ft., or 3 in.

3 ft. 9 in. will be represented by a line drawn from the figure 3 back to the third subdivision.

Work out an example to this scale of some large object, ignoring dimensions less than 3 in.



At a future lesson divide the first space into twelve parts thus:

Each subdivision then represents 1 in.

Again the same scale may be used for still larger objects, by considering each one-inch space as representing 1 yard, that is, a scale of $\frac{1}{36}$, or 1 in. to 1 yard. Each subdivision will then represent ¼ yard, or 9 in.

To make a simpler scale for pupils of this age, have 3 subdivisions substituted for 4. Each division will then represent 1 ft.

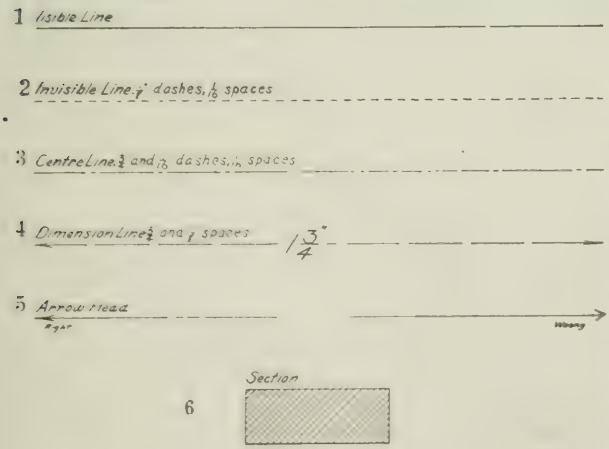
Make a plan of the room to the scale of 1 in. to 1 yard.

Use three subdivisions and ignore measurements less than 1 foot.

THE READING OF A DRAWING

In all mechanical drawings lines have a certain definite meaning. Just as in reading a book letters are used to form words and these again to form sentences, so lines of different kinds are used in drawing to convey certain definite meanings. A draughtsman, by the proper use and arrangements of his lines, enables a workman to read a drawing. In some of the more advanced forms of mechanical drawing, for example, in building construction, a man, when examining a properly draughted plan and elevation, can tell at a glance the different kinds of material to be used in different places in the building, as planned by the designer. Drawing is, therefore, the language by which the designer speaks to the workman.

In this Manual, however, we are dealing only with the very simplest form, the very A B C, as it were, of draughting, and shall require but a few lines to express the meanings desired.



1. To show the true shapes of all finished objects.

2. To show unseen edges of such objects. They are also used for scored lines in cardboard work.

3. Used in those drawings in which measurements have to be taken from the centre.

4. To show dimensions.

5. It is important that the arrow heads in 5 should be placed at the very commencement and also at the termination of every length of line dimensioned. This will be obvious when we consider that we often require to show several measurements along one continuous line.

6. Parallel lines, generally at an angle of about 45 degrees, to show sections or cut surfaces.

In drawings showing the end grain of lumber curved lines are sometimes drawn to represent the annual rings.

THE USE OF DRAWING-BOARDS, T-SQUARES, AND SET-SQUARES

The pupils should be taught the use of the drawing-board as early as possible, for by it, in conjunction with the T-square and set-squares (or triangles, as they are often described), the work of mechanical drawing is much simplified.

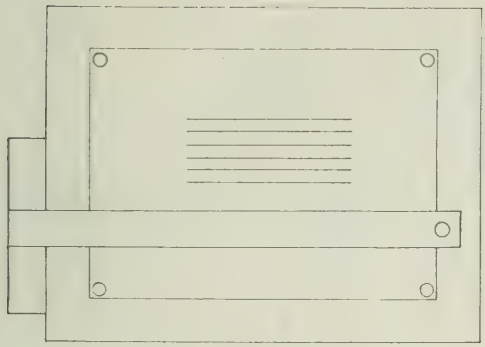
After the pupils have learnt the geometrical construction necessary to enable them to draw lines at right angles to each other and have had sufficient practice to fix that construction well in their minds, it is a waste of time and energy to employ it when many lines are to be drawn perpendicular to each other. These lines can be drawn quickly and accurately by means of the T-square and set-squares.

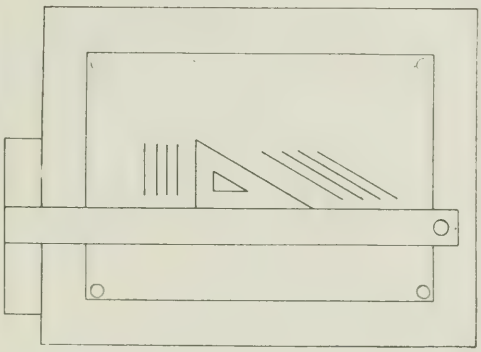
The drawing-board should have a good level surface, with its adjacent edges at right angles to each other.

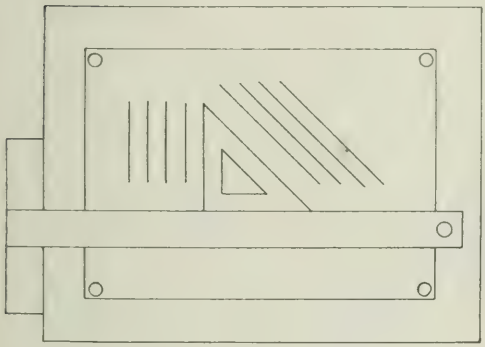
The T-square derives its name from its shape, and must be used with the left hand, leaving the right hand free to draw the required lines. The cross bar or head of the T-square is always placed along the left-hand edge of the drawing-board, so that by sliding it along the edge, any number of horizontal parallel lines can be drawn.

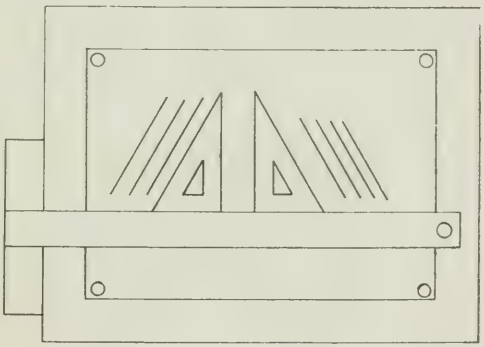
The set-squares are placed against the edge of the T-square when in position on the drawing-board, and with these, vertical lines and lines at various angles may be drawn. By sliding the set-squares along the edge of the T-square, a large number of parallel lines can be drawn in these directions. If no T-square is available, the set-squares can be used against the edge of a straight, flat ruler, but they are not likely to produce such accurate results as when they are placed against the edge of the T-square.

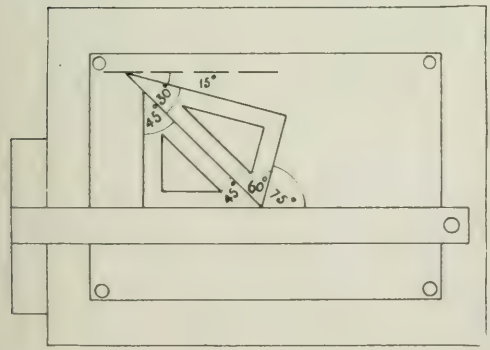
Place the paper on the drawing-board with one edge parallel to the edge of the T-square, and fasten with drawing pins. Draw lines in various directions and at various angles, in order to acquire facility in the use of the instruments.







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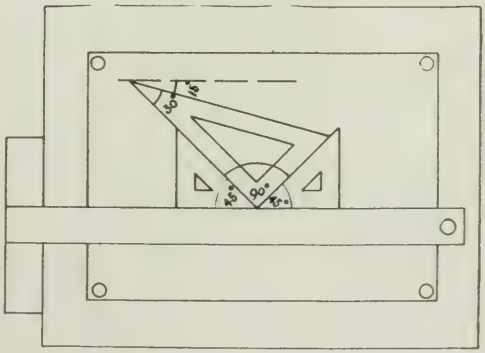
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PLANS AND ELEVATIONS

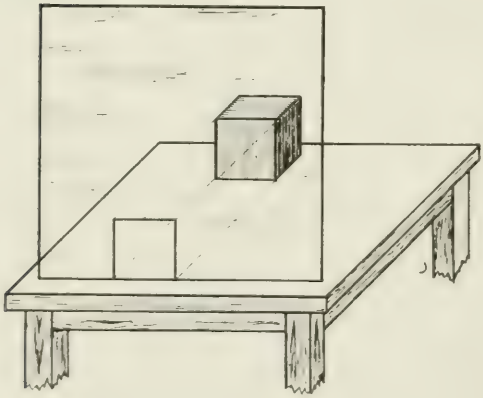
Before a building can be erected or any object can be made, the workman must have working drawings on which all the necessary dimensions are shown. These working drawings consist of two or more views of the object as seen from different angles, and are called top view (plan), front view (front elevation), and end view (end elevation), as the case may be.

These views differ from pictorial representations of objects such as are found in photographs and perspective drawings. Such views give a fair idea of the form, general proportion, and appearance of the object, but are of no use to the workman for constructive purposes. In such drawings, lines which are parallel in the object may appear to meet in the drawing; lines which are equal in the object may be unequal in the drawing; and the angles may be either greater or less than those of the object. It is impossible, therefore, to use such drawings for purposes of measurement.

Working drawings, in order to be of service and to be an absolute guide to the workman, must represent the exact form and dimensions of the lines and surfaces of the object and show their true relationship to one another. In other words, working drawings must show objects as they *are,* while pictorial and perspective drawings show objects as they *seem.*

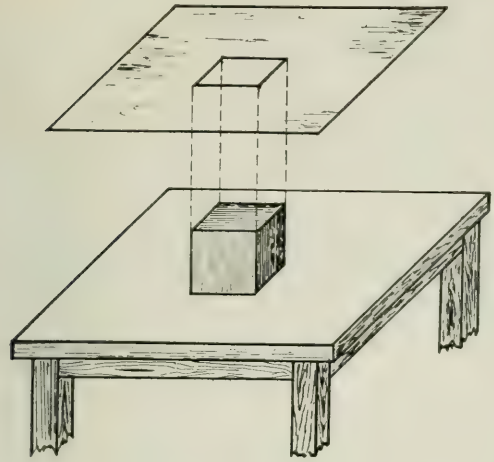
The basic principle of correct working drawings is not difficult to understand, and every endeavour should be made to give the pupils a clear idea of it. Thorough teaching at this stage will be well repaid. Some such method as the following is suggested.

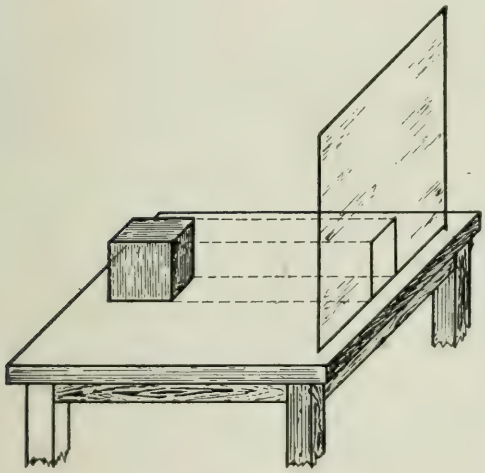
METHOD OF TEACHING SIMPLE PLAN AND ELEVATION

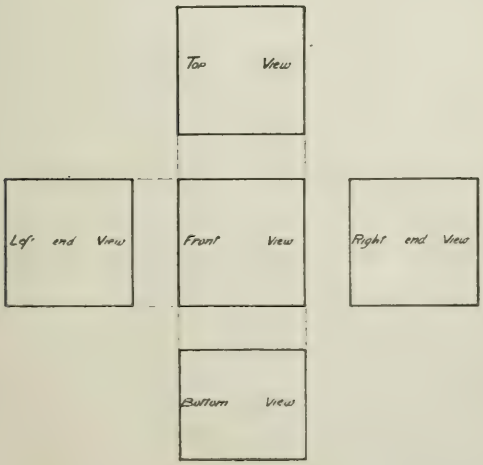


We wish to represent the different views presented by an ordinary cube. To illustrate the method of obtaining these views, a pane of clear glass may be placed in front of the cube. A cube is shown on a table; in front of it, parallel to one face (the front face) of the cube, the pane of glass is placed.

Now, when the observer looks directly at the front of an object from a considerable distance, he will see only one side, in this case only the front side of the cube.







The rays of light falling upon the cube are reflected into the eyes of the observer, and in this manner he sees the cube. The pane of glass, evidently, is placed so that the rays of light from the object will pass through the glass in straight lines to the eye of the observer. The front side of the object, by its outline, may be traced upon the glass, and in this manner a figure may be drawn on it (in this case a square), which is the view of the object as seen from the front. This view is called the front view, or front elevation.

One view is, however, not sufficient to show the real form of a solid figure. In a single view two dimensions only can be shown—length and height; hence the thickness of an object will have to be shown by still another view of it, known as the top view.

Now place the pane in a horizontal position above the cube which is resting on the table, and, looking at it from above directly over the top face of the cube, trace its outline upon the glass. As a result, a square figure is drawn upon the glass, which corresponds to the appearance of the cube as seen from above. This square on the glass is the top view of the cube, or its plan.

The next figure shows the manner in which a side view of the cube may be traced. The glass is placed on the side of the cube, which rests on the table as before, and the outline of the cube on the glass in this position is called its side view, or side elevation.

Usually any two of the above-mentioned views will suffice to show all dimensions and forms of the object. In complicated pieces of machinery, however, three, and even more views, may be required to represent adequately the proportion and form of the different parts.

A drawing which represents the object as seen by an observer looking at it from the right side is called the right side elevation, or view, and a drawing showing the object as it appears to the observer looking at it from the left side is called the left side elevation, or view.

A view of the object as seen from the rear is called the rear view, or rear elevation, and a view from the bottom, the bottom view.

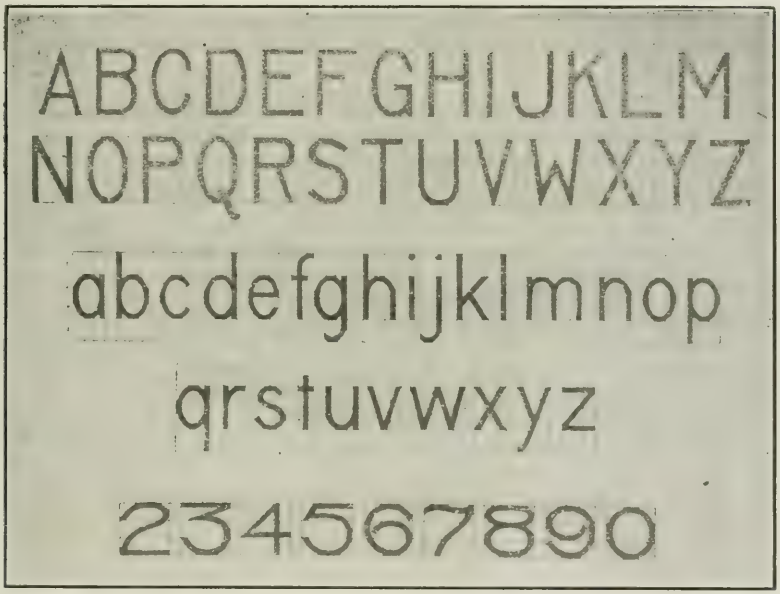
The different views of an object are arranged on the drawing in a certain fixed and generally adopted manner, thus—

The front view is placed in the centre; the right side view is placed to the right of the front view, and the left side view to the left; the top view is placed above the front view, and the bottom view below it. The different views are placed directly opposite each other and are joined by dotted lines called projection lines.

LETTERING

Every working drawing should be carefully lettered, no script being allowed. Letters are of many types and their proportions vary, but all are governed by certain rules of form and construction. For the purpose of lettering working drawings, a simple style of alphabet is desirable. Probably one of the most suitable types admitting of modification of proportions for various purposes is the one shown below.

The proportions of this type of letter are 2 to 3, that is, the width of each standard letter is two thirds the height. All but 3 letters are this standard width—M and W are one fourth wider and I is half as wide. To plan an alphabet of this type, draw a rectangle as wide as the letters are intended to be high. Divide this rectangle by horizontal lines into 3 equal parts. Set off on the upper line the width (two thirds the width of the rectangle) of each letter, leaving spaces between each about one third the width of the standard letter.



Draw vertical lines through these points. A visiting card makes a good straight edge. A finely-pointed pencil is necessary. Notice how the horizontal lines help in the formation of many of the letters. All construction lines should be very lightly drawn, as they must not show when the work is completed. The letters should be sketched lightly within the planned spaces. When they are correctly formed, darken the lines with brush, pen, or pencil.

For an alphabet of small letters construct a rectangle as previously described. To this add an extra division, to accommodate the downstrokes of g, j, p, q, and y. The body of the letter will occupy the two central divisions of the rectangle.

In printing titles, plan your letters for the space they are intended to occupy. Practise first on a separate sheet.

The figures shown are each planned to occupy a square.

In planning alphabets, the proportions here given are merely suggested, and any other proportions may be adopted. Indeed it is well to allow the pupils to make modifications and design alphabets for themselves.

(See pages 88, 110, 147, 188, 231, 281, 331, of *The Ontario Teachers' Manual on Art.*)

WORK IN THIN WOOD

This forms an excellent introduction to ordinary bench work in wood. The wood is supplied planed to thickness and should be straight-grained and free from knots.

Basswood is very suitable. Each pupil should be taught to sharpen his own knife. Knives must be kept in a satisfactory condition if good work is to be done.

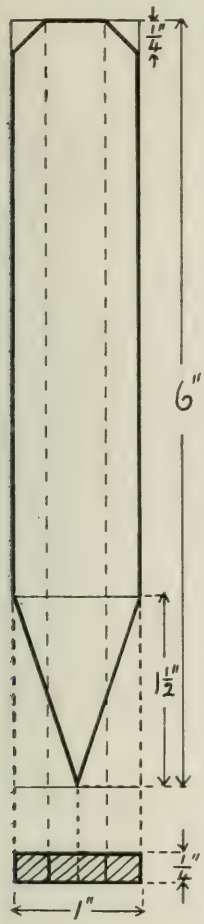
The models are intended to be suggestive both in design and in character, and should not be regarded as a prescribed course to be rigidly followed.

Before cutting with a knife the grain of the wood should be carefully examined. Cut with the grain, never against it.

The hand should never be placed in front of the cutting edge. In planning a course of work in this material, the teacher should remember that the instructions here given are to enable him to understand the technique of the tool manipulations and to make the model before his presentation of it to the class. These instructions are not an indication of the way in which he is to develop the lesson. Each lesson should be properly prepared and developed in such a way as to bring in all the correlated facts, and should not be treated merely as an exercise in making a pencil sharpener, a string winder, a plant label, etc.

It will be necessary to draw the model carefully before it is made. In the more simple cases, this drawing may be on the wood itself, and the pupils may be allowed to work from a black-board drawing prepared by the teacher or by themselves under his direction. In other cases, a properly lettered and dimensioned working drawing should be made.

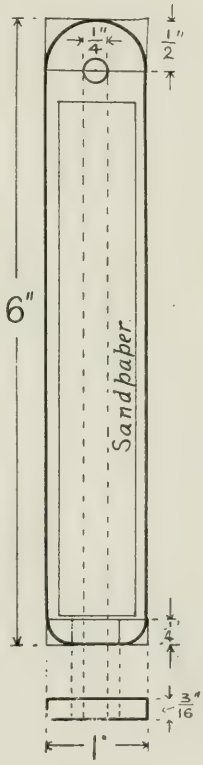
Occasionally, the pupils should be allowed to take their own measurements from the prepared model and make their drawings from the measurements thus obtained.



1. *Plant Label*:

This is drawn in a rectangle 1 in. x 6 in. Complete the drawing as shown. Cut to width. Shape the point. Measure the length from the point end. Set out the shape of the top as desired. Finish the cutting.

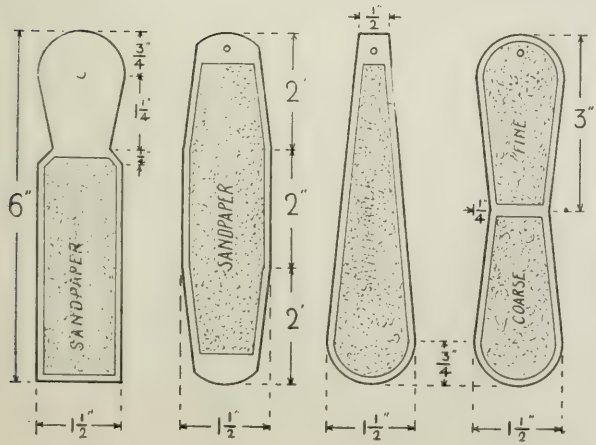
The drawing of these models provides the opportunity for carefully reviewing and extending what has been taught of plan and elevation.

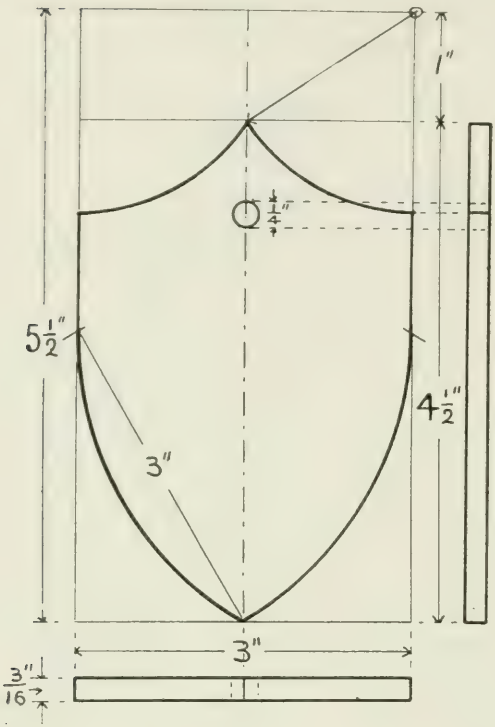


2. *Pencil Sharpener*:

Proceed as in the previous model.

Ends of a different pattern may be designed. The sand-paper should be thinly glued, care being taken not to miss the edges. If sand-paper be glued on both sides of the model, warping will be largely prevented. Four alternative designs are shown.



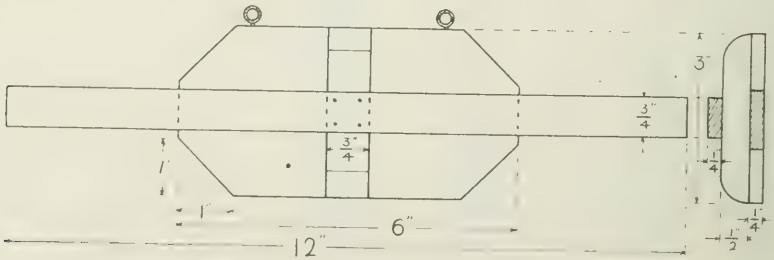


3. *Match Scratcher or Calendar Back*:

This must be carefully drawn. Construct a rectangle 3 in. x 3½ in. Bisect the shorter sides and join the points. Describe the arcs with centres as shown. Cut to shape. The length of the model should be in the direction of the grain of the wood. If intended for use as a match scratcher, attach sand-paper.

4. *Tie Rack*:

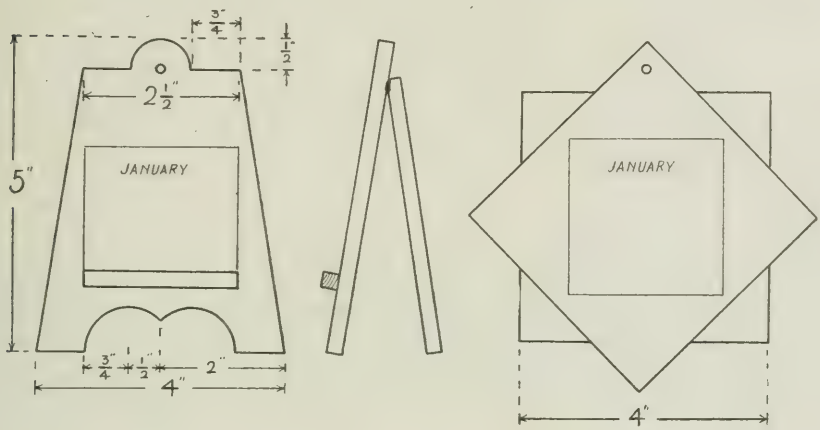
This is a popular model with boys and is easily made. The back should be carefully made, and the two cross strips should be nailed exactly in the centre of it. The rack is hung by the two screw rings, and the ties are placed over the long cross-bar.

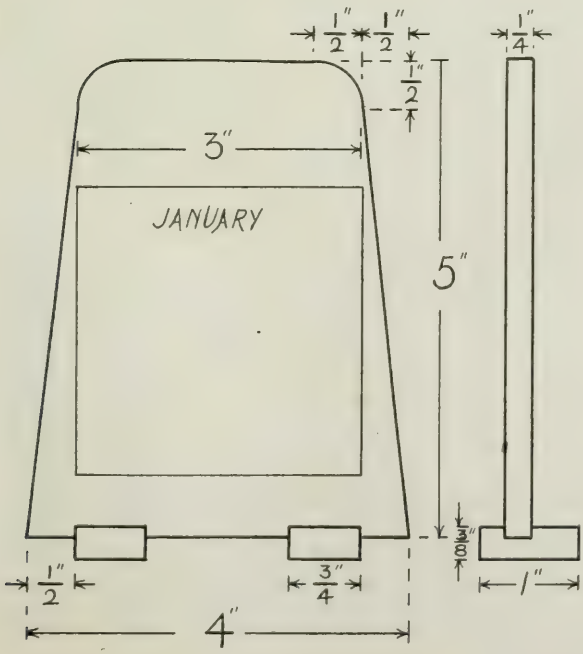


5. *Calendar Backs*:

Various forms of these may be made, and calendar pads should be pasted on to them. Three forms are shown. The back of the easel is joined either by a small hinge or by a piece of passe-partout binding. Calendar pads in various sizes may be purchased cheaply.

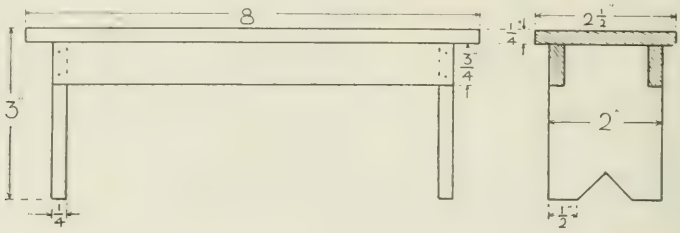
The square form may be cut from one piece or made from two squares overlapping.





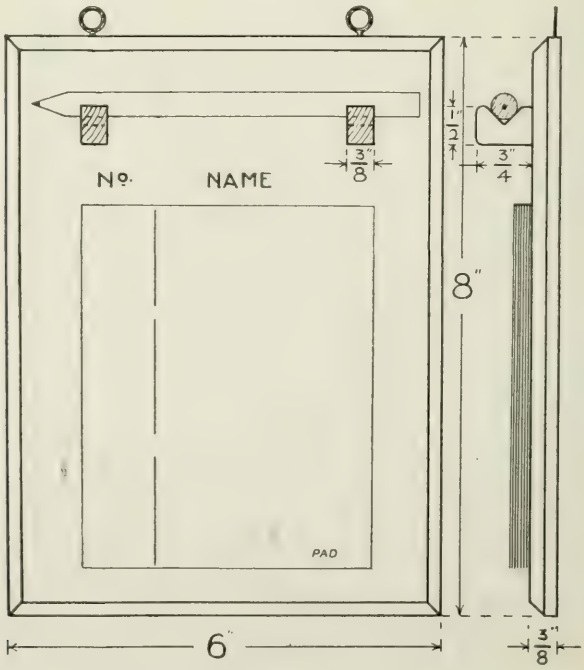
6. *Bench*:

Cut the top piece first, then the side rails, then the legs. Be sure that the legs and the side rails are exactly alike. Cut the slots in the legs for the side pieces to fit and nail the frame together. Nail on the top, being careful that it overlaps equally all round.



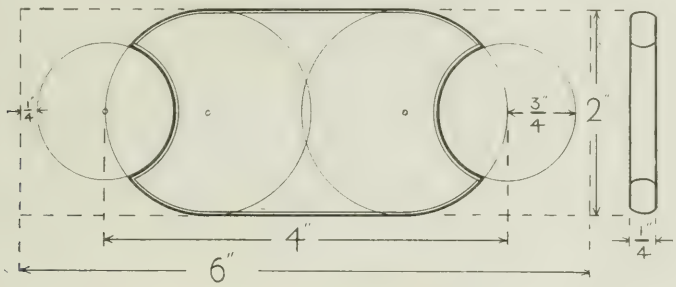
7. *Telephone Call Pad*:

This consists of a piece of thin wood 6 in. x 8 in., with two pieces nailed on as a rest for the pencil. Make the back and cut the bevel all round, finishing with sand-paper. Cut the pieces for the pencil rest and nail them to the back, Glue on the pad. A different design for the top may be chosen if desired.



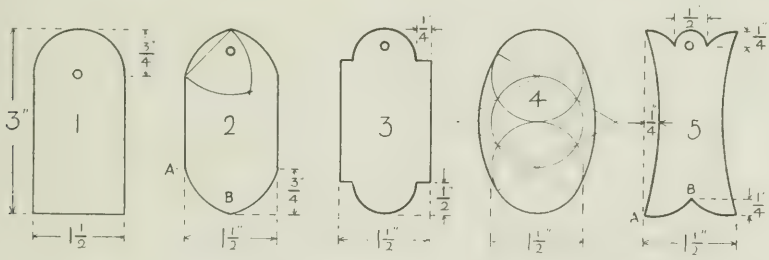
8. *String Winder*:

The drawing shows how to lay out the pattern. A piece of wood 2 in. x 6 in. is required. Draw the circles as shown. To obtain the end curves, bore two holes with the brace and bit and saw off the waste wood.



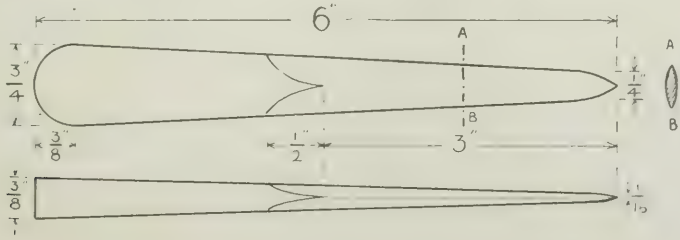
9. *Key Labels*:

These may be made in many different forms. Five patterns are shown. To obtain the curves in Figures 2 and 5, join points A and B, and on AB describe an equilateral triangle. The apex of the triangle is the centre of the curve required. Make the other curves in the same way. The labels are all made from wood 1/4 in. thick, 1½ in. wide, and 3 in. long, except No. 4, which requires material a little wider. The drawing of this shows how to construct an ellipse of given length but of unknown width.



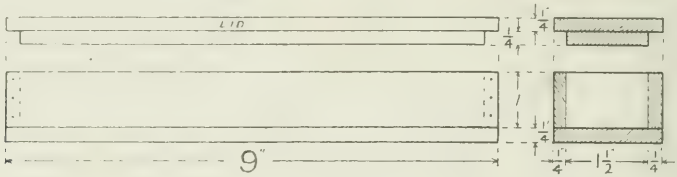
10. *Letter Opener*:

As the drawing shows, the letter, or envelope, opener is tapered both in width and in thickness. The blade is whittled, scraped, and sand-papered to a thin double edge, and the end is pointed. A little decoration for the handle would be an improvement.



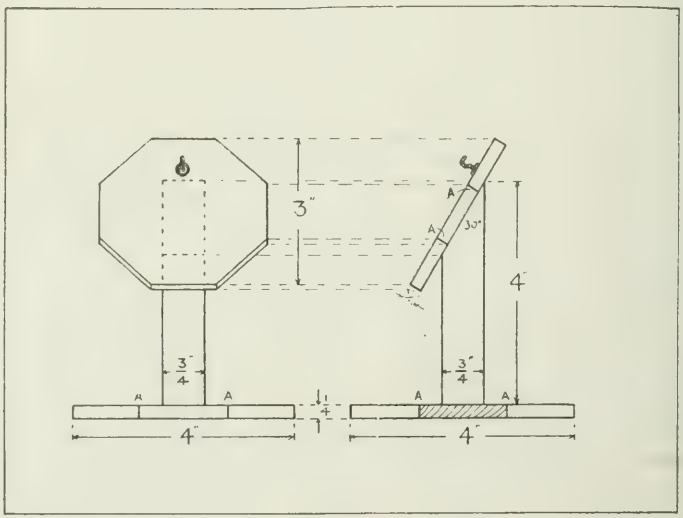
11. *Pencil Box*:

This is an attractive model and is very useful when made. Cut the two sides 9 in. x 1 in., and the two ends 1½ in. x 1 in., and nail the frame together, testing the angles for squareness. The bottom is 2 in. by 9 in., and the top the same size. The under piece of the top is ¼ in. less all round than the upper piece. This may be nailed from the under side with ⅜ in. brads. or the whole lid may be cut from one piece.



12. *Watch Stand*:

The base and the sloping shelf may be be octagonal, hexagonal, or circular. In order to obtain the exact position of the lines and points marked A, it will be necessary to make drawings of the two octagons, one with 3-in. sides and one with 4-in. sides. The parts may be nailed or glued together.

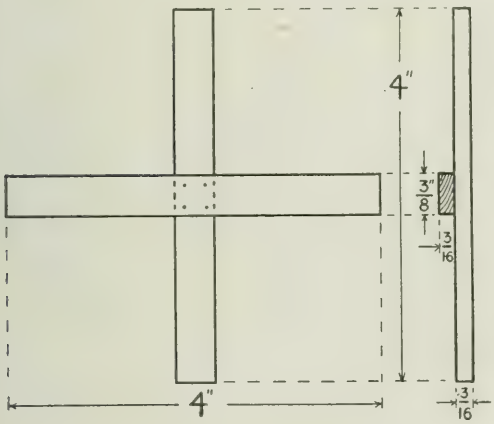


STRIP WOOD-WORK

The models suggested below are those used in the Course that has been drawn up by the Supervisor of Manual Training, for the Ottawa Public Schools. It has been worked out successfully, and is recommended for adoption with such modifications as the ingenuity of teacher and pupils may suggest or the requirements of the district in which the school is situated may demand. Many objects

other than those illustrated may be made, particularly if cardboard is used in conjunction with the strips. It should be the aim at all times to stimulate inventiveness and originality. Every fourth lesson is used as a free expression period, in which the small strips sawn off from the longer pieces are used up. All right angles should be judged by the eye before being tested by the square, and all lengths should be judged by the eye before being actually measured by the rule. The success of the work from an educational point of view depends very largely upon the methods adopted in teaching and the degree of accuracy insisted upon. No measurement less than 1/8 in. is required, and the pupils should be able to measure the distance accurately. The models are frequently taken home to be stained or painted and brought back to the school to be exhibited. Both boys and girls have done this work very successfully.

SUGGESTED MODELS



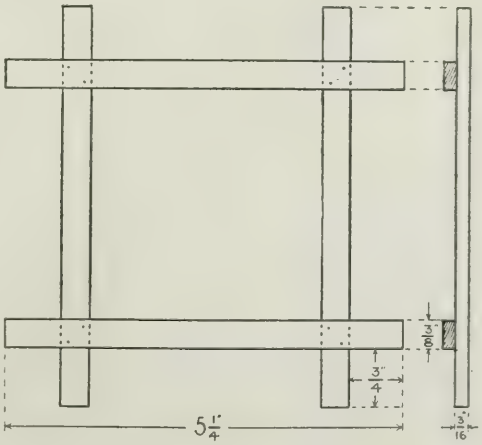
1. *String Winder*:

One end is first squared. The lengths are then sawn and the ends smoothed. The position of the first nail is marked by a dot, and a nail is driven just through one piece. The point is placed in position on the second piece, driven through, and the nail clinched. A large boot protector driven into the cutting board may be used to clinch the nails on. The angles are then examined and tested, and, when correct, the remaining nails are driven through and clinched.

2. *Picture Frame*:

One nail should be driven into each joint, and the angles tested before the other nails are driven.

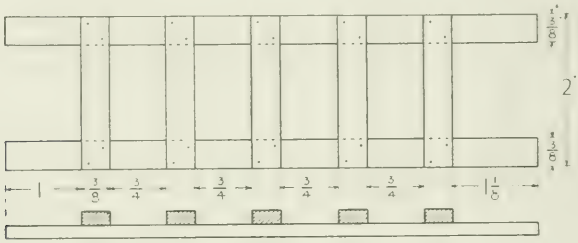
A definite size is given, but in practice it is best to frame a post-card or other picture brought by the pupil.

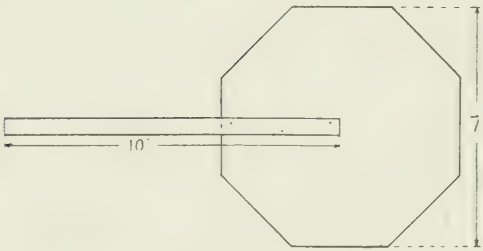


3. *Ladder*:

Follow the practice in each model of having the pupil calculate the total length of wood required, for example:

Two pieces 7 in. long equals 14 in.
Five pieces 2 in. long equals 10 in.
Total, 24 in. equals 2 ft.



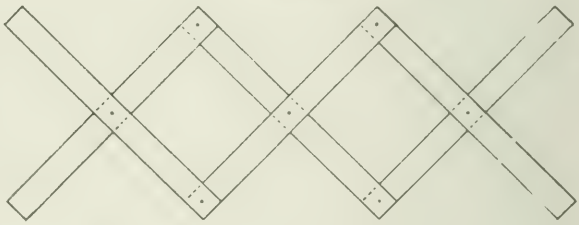


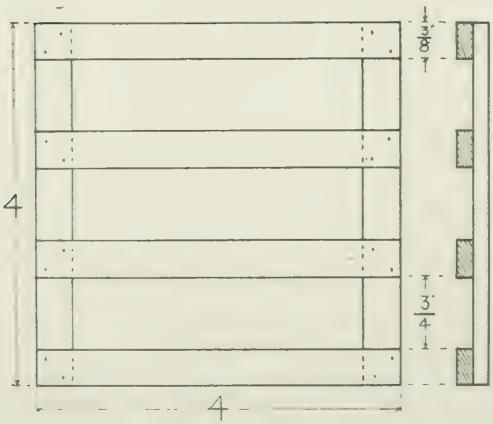
4. *Fan*:

The handle is of 2 pieces 8 in. long, and the fan is nailed between. This may be of thin cardboard. Any shape may be used. An octagon in a 7-in. square is shown.

5. *Movable Trellis*:

Each piece is 4 in. long. If one nail is placed at each joint, the trellis may be moved in and out. Feathers or cut out cardboard figures may be tacked on the ends.





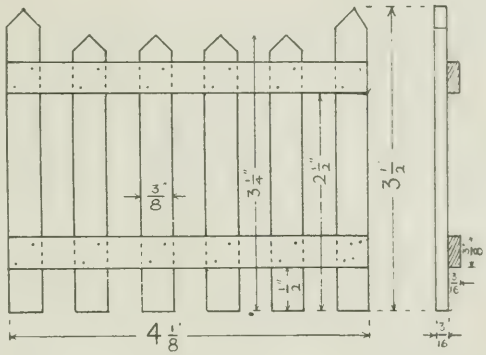
6. *Flower-pot Stand*:

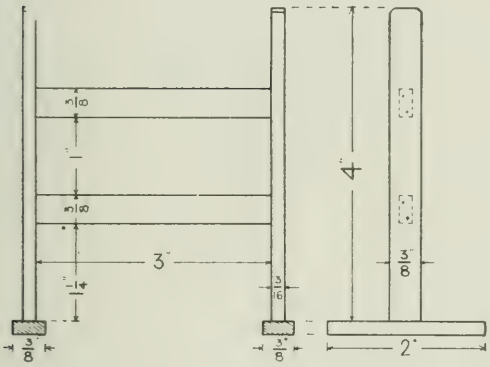
This is used to prevent a flower-pot from coming into contact with the window-sill. It will be seen that the figure formed is a square. An opportunity is thus afforded to review the definitions, etc., of a square and of a right angle. Nail each corner with one nail and test for squareness before driving the remaining nails

7. *Gate*:

Two pieces 3½ in. long equals 7 in.
Two pieces 4⅛ in. long equals 8¼ in.
Four pieces 3¼ in. long equals 13 in.
Total, 28¼ in. equals 2 ft. 4¼ in.

Show the pupils how to saw the ends of the uprights at angles of 45 degrees on the cutting board.



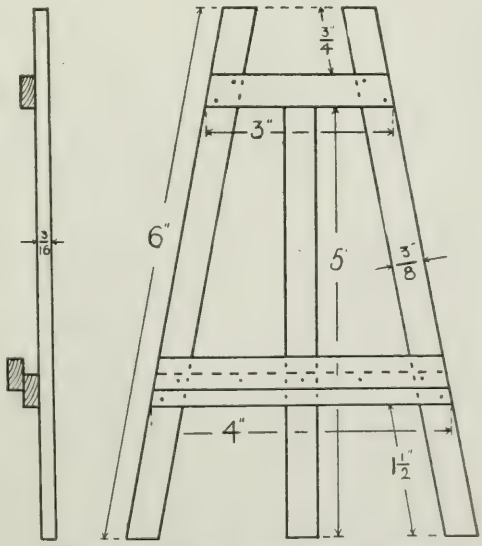


8. *Towel-horse*:

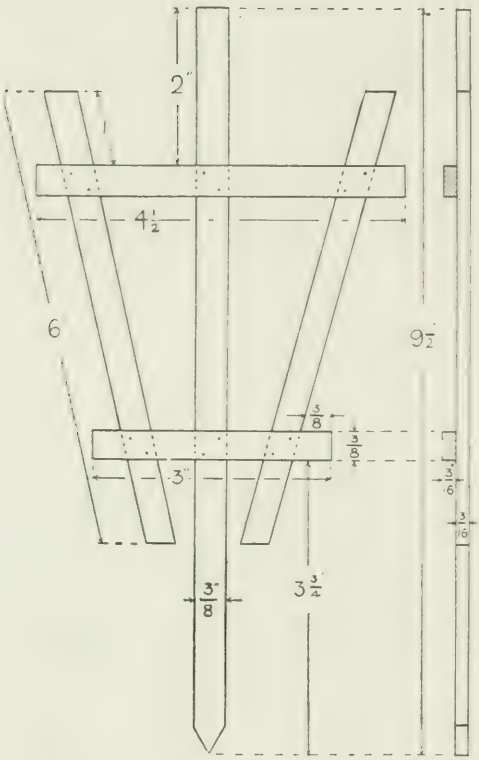
The two horizontal pieces fit in between the two uprights and are nailed through as shown. Where pieces fit in between other pieces, as in Nos. 6, 9, 11, 14, and 19, the ends should not be sand-papered, but should be left from the saw.

9. *Easel*:

The back leg is 5 in. long and is attached by a hinge of stout paper or passe-partout binding. The rabbet on which the picture rests is made from two strips nailed together.

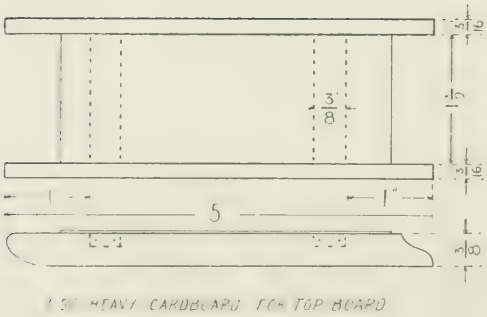


BACK LEG 5" LONG . PASSE PARTOUT HINGE



10. *Plant Support*:

One piece 9½ in. long equals 9½ in.
Two pieces 6 in. long equals 12 in.
One piece 4½ in. long equals 4½ in.
One piece 3 in. long equals 3 in.
Total, 29 in. equals 2 ft. 5 in.
The point is sawn at angles of 45 degrees.



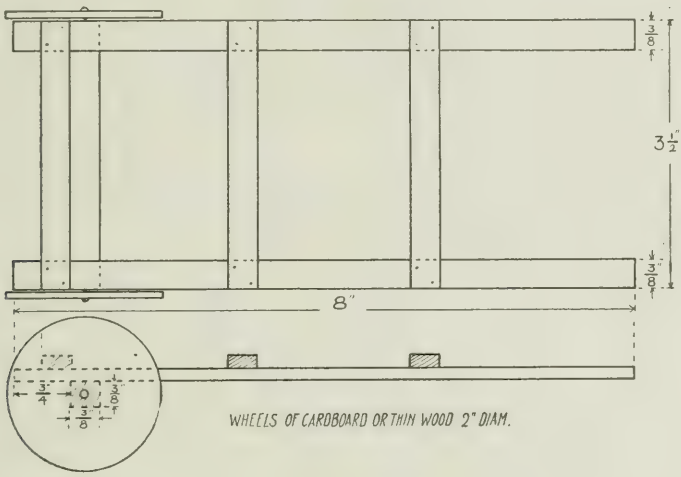
11. *Sleigh*:

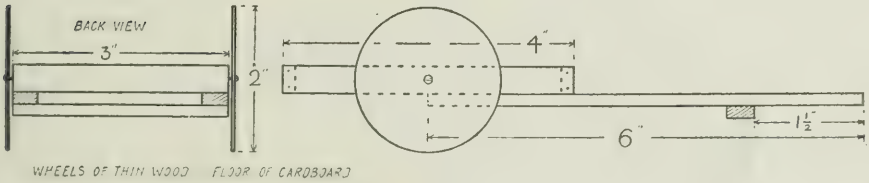
The cross-pieces fit in between the 5-in. strips and are nailed through. The ends of the runners are rounded off with sand-paper. Use heavy cardboard (known as wood-board to the bookbinder) for the top. This may be cut by the pupils with a knife; but as a rule it is better, in the earlier stages, that it should be provided by the teacher, cut to the correct size.

12. *Cart*:

The shafts are 8 in. long. The cross-pieces are 3½ in. long. The axle is made of two pieces nailed together. The wheels are 2 in. in diameter and are made from cardboard or thin wood.

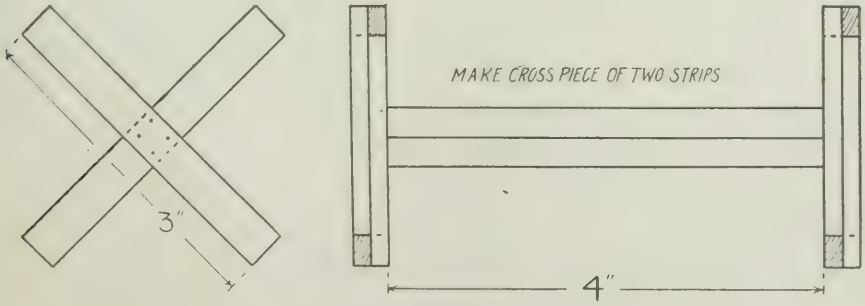
Another form of cart is shown, the body of which is 4 in. long and 3 in. wide. The shaft is 6 in. long. The wheels are of thin wood 2 in. in diameter, and the floor is made of cardboard.





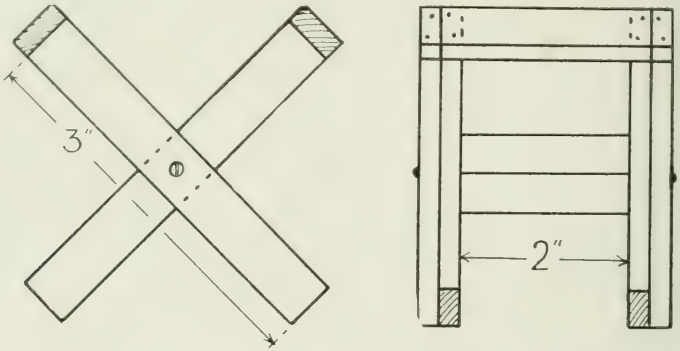
13. *Saw-horse*:

This requires great care in making. The cross-piece is made by nailing two pieces together. (4 in. long)

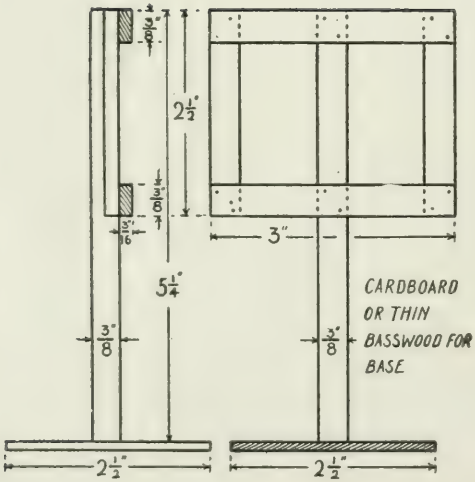


14. *Camp Stool*:

A modification of the previous model. Two cross-pieces are nailed on the top, and a piece of cloth or woven material (raffia, etc.) is tacked on to represent the seat. Instead of nails, screws may be used to join the side pieces which form the ends.



SEAT MADE OF WOVEN RAFFIA

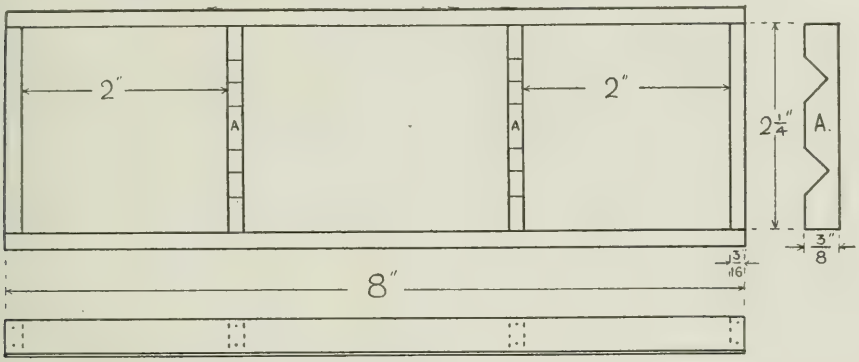


15. *Calendar Stand or Notice Board*:

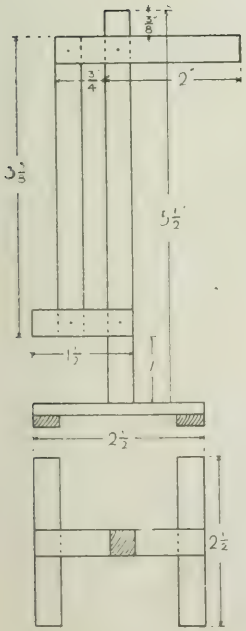
The upright consists of two strips nailed together and is 5¼ in. long. The base is stiff cardboard or thin basswood, 2½ in. square, and is glued and nailed to the upright. The back may be covered with a piece of cardboard.

16. *Pen Tray*:

The base of this is of stiff cardboard cut to size and glued and nailed on. The centre pieces are slightly notched, as shown in the drawing, in order to hold the pens.



CARDBOARD BOTTOM

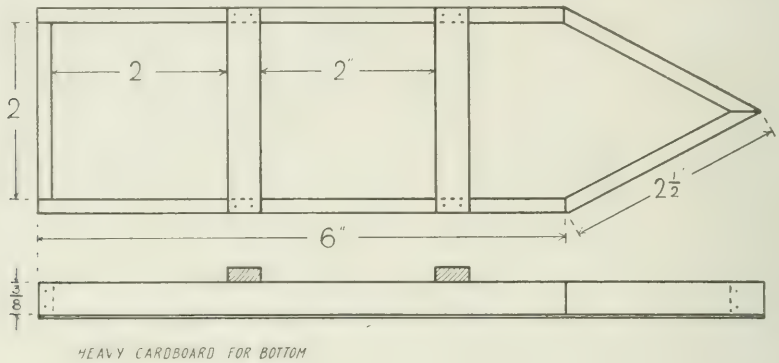


17. *Signal Post*:

The main upright (5½ in. long) consists of two strips nailed together and glued to the wooden base, which is 2½ in. square. One nail is placed at each joint, in order to allow freedom of movement. The signal arm may be coloured with red ink.

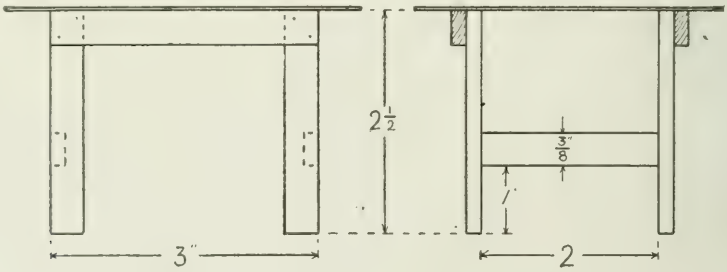
18. *Boat*:

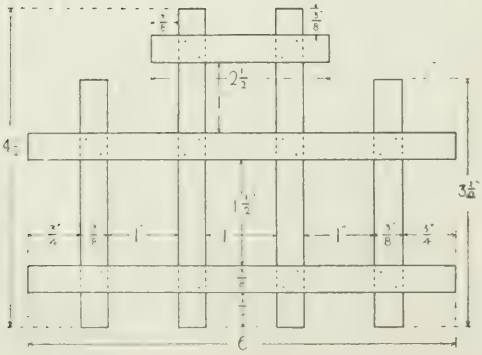
The bottom is of heavy cardboard. What are the angles required? Saw them carefully and glue them together.



19. *Table*:

The top is of wood-board 4 in. x 3½ in. See that it is tacked on so as to lap over evenly on all sides.



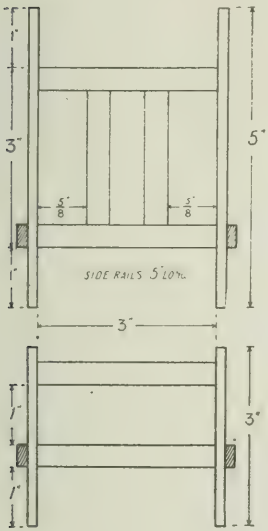


20. *Key Rack*:

Calculate length of strips required.
2 at 6 in. long equals 12 in.
2 at 3½ in. long equals 7 in.
2 at 4½ in. long equals 9 in.
1 at 2½ in. long equals 2½ in.
Total, 30½ in. equals 2 ft. 6½ in.

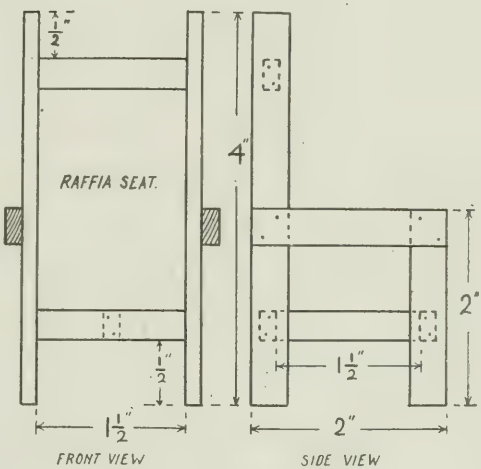
21. *Bed*:

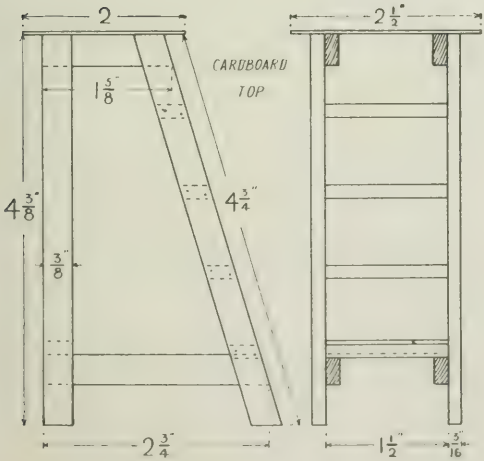
Make each end separately and join by side rails 5 in. long.



22. *Chair*:

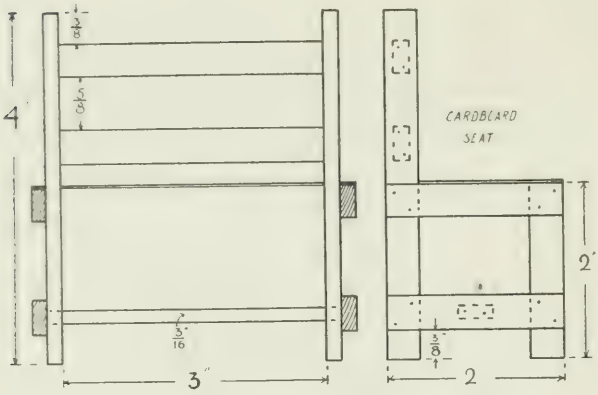
The seat may be made of raffia or any other woven material.





23. *Step-ladder*:

The sides must be made in pairs right and left. The top is a piece of wood-board 2½ in. x 2 in.

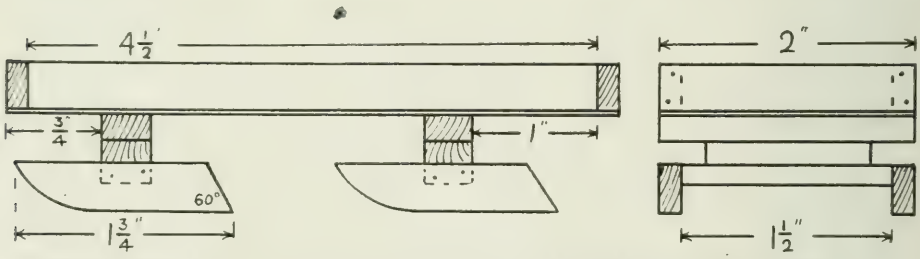


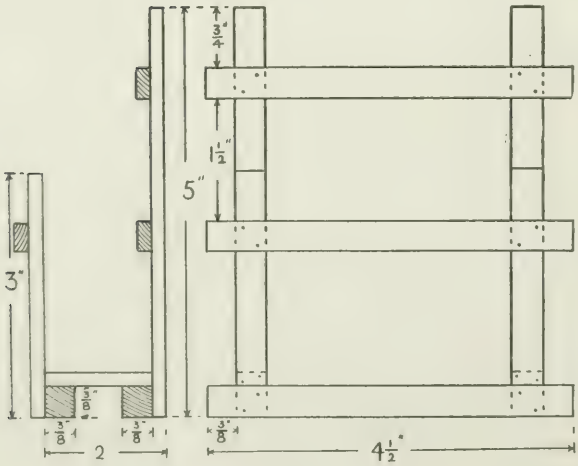
24. *Settle*:

The seat is of wood-board.

25. *Bob-sleigh*:

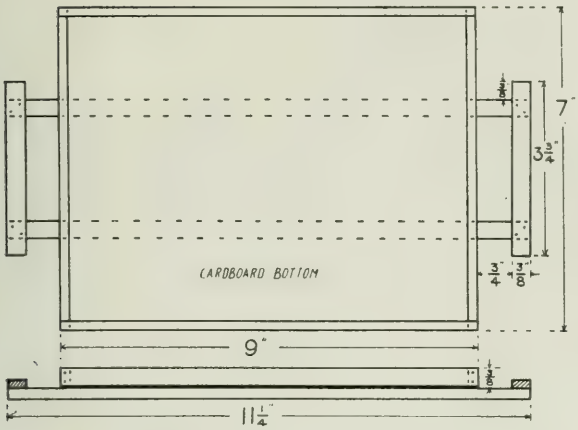
The front pair are left loose, using only one nail. The top of the sleigh is of wood-board.





26. *Letter-rack*:

Calculate the number of pieces and the lengths required. Nail the back first, then the front. Join together.



27. *Tea-tray*:
The bottom is made of heavy cardboard, cut to size and nailed on.

Many of the above objects are shown on page 143. They may also be made from natural twigs which have been gathered and dried by the pupils. For this work the willow, the elder, the hazel, the pine, and various fruit trees yield suitable material. The twigs cut from trees and shrubs in the late autumn should be gathered and left to dry for this purpose.

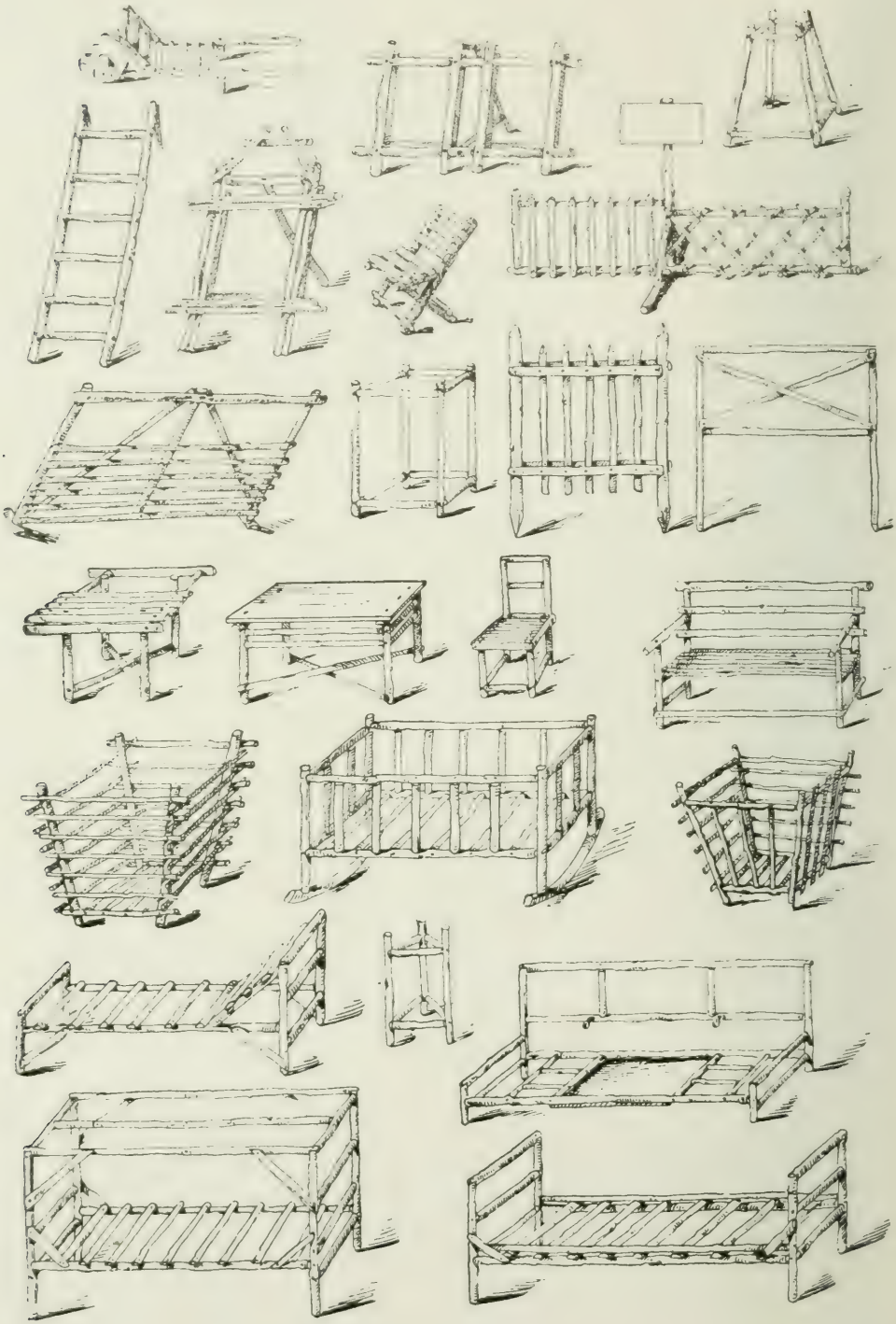


Plate 29.—Objects made from twigs

STRIP WOOD-WORK

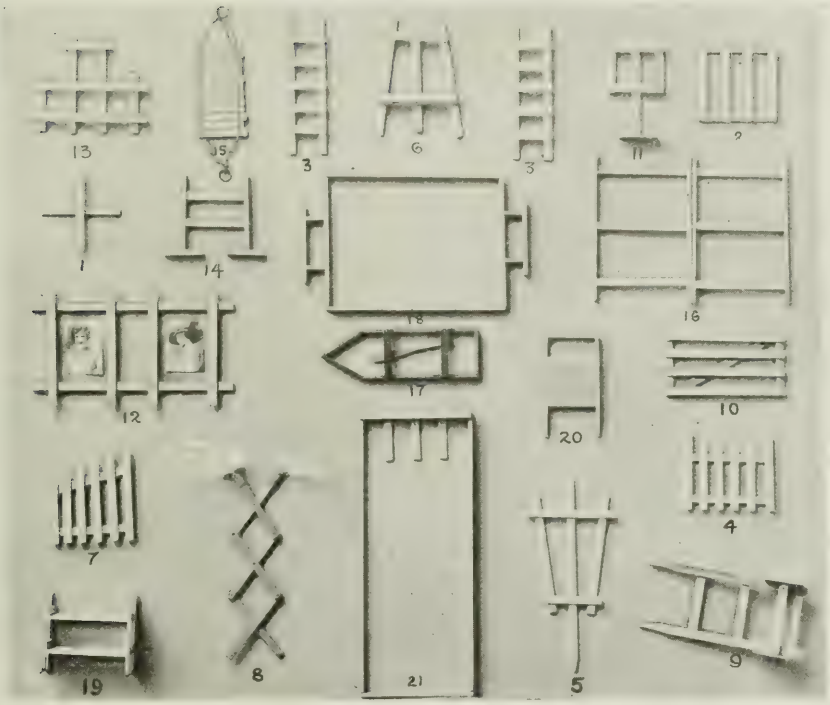


Plate 30.—Strip wood-work

1. String Winder
2. Plant Stand
3. Ladder
4. Gate
5. Plant Support
6. Easel
7. Gate
8. Toy or Trellis
9. Hand-cart
10. Gate
11. Calendar Stand
12. Photograph Frame
13. Key Rack
14. Towel-horse
15. Hammock
16. Clothes-horse
17. Row-boat
18. Tea-tray
19. Book-stand
20. Wash-board
21. Marble Board

FORM IV

CLAY

MODELLING FROM NATURE

If this subject has been taught systematically, the pupils will now be able to model natural objects with a fair degree of success. This will supplement nature study, since it is impossible to study well without close observation of the objects. In this way the salient features of types of plants can be well illustrated. Fruits, leaves, nuts, and some vegetables provide good exercises in modelling.

The average person imagines that he knows all about the characteristic features of the common objects around him, but on being called upon to represent these, he finds how little he knows; for example, the points of difference between the snout of a pig and that of a dog, the general form of the head of a dog compared with that of a sheep, or the form of the thigh of one animal compared with that of another.

MODELLING FROM CASTS

Casts of portions of good ornaments may be modelled with advantage.

The study of such ornamental work prepares the pupil to design and model patterns suitable for this particular material, and for the industrial purposes to which these may be applied.

Portions of the human figure, such as hands in various positions, feet, eyes, ears, mouth, may be used as models, before proceeding to work from the human figure itself.

Modelled heads of animals or human beings in various degrees of relief—high, low, or medium—make very good ornaments.

DESIGN

There is great scope for this in modelling. In the modelling of tiles for various purposes, design has already been suggested in the preceding Forms. This may now be considerably extended both in character, detail, and purpose.

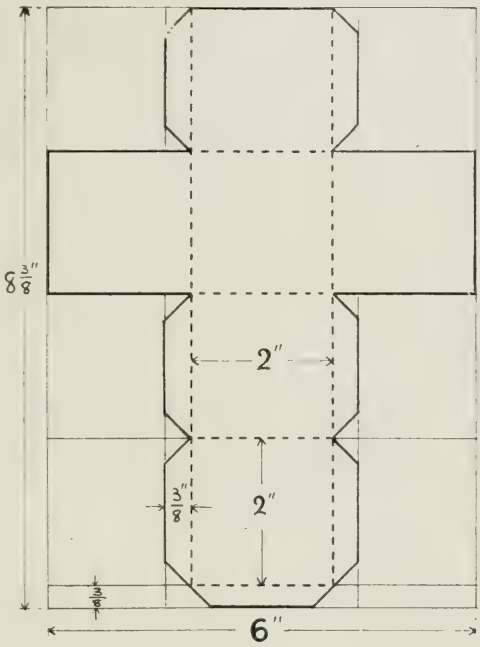
The pottery of Form III lends itself to the application of design in various ways. The general lines of the model itself, the shapes of handles and spouts and bases should all be considered in their relation to each other. Additional ornament may be obtained by incised patterns or by modelled overlay work. A study of the pottery in many of the better stores will suggest ideas for the treatment of this branch of modelling. Many good examples of design may be seen in the plaster work in our chief buildings. In museums, copies of choice examples of plaster pilasters and historic ornaments may be seen and studied with advantage. Photographs of the above may be worked from with good results.

The principles underlying designing are as applicable to clay work as to any other form of art and will repay careful study.

CARDBOARD CONSTRUCTION

1. *Cube*:

This figure is included in a rectangle 6 in. x 8 in., which is divided into 12 squares with an addition of ⅜ in. to the length for a pasting flap. Complete the drawing as shown. The cube may be covered with coloured paper and made into a money-box, if desired, by cutting a slot in one of the faces.

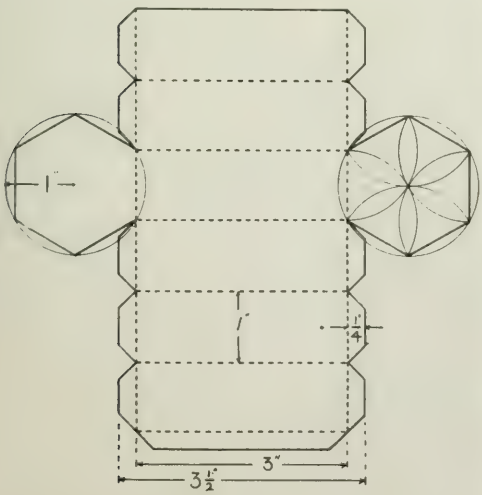


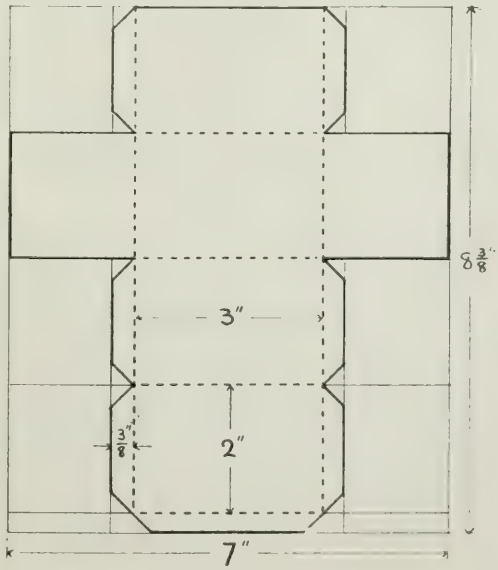
Lesson on the Cube

Each pupil should be provided with a cube and be led to discover the number of its faces and edges, the shape of the faces, and the length of the edges. At this stage the pupils should be able to make the drawing without assistance.

What kind of figure is each face? Find its area. How many inch cubes could you place in the model? What is the difference between two cubic inches and a two-inch cube? The edges of a cube are four inches in length; how many square inches are there in each face? What is the total area of the surface of the cube? How many cubic inches would such a cube contain? The edges of a cube are twelve inches. What is the area of each face? A wooden two-inch cube weighs one-half pound. What would a six-inch cube weigh if made of the same material? Make a working drawing of a cube having an edge three feet to the scale of one inch to one foot.

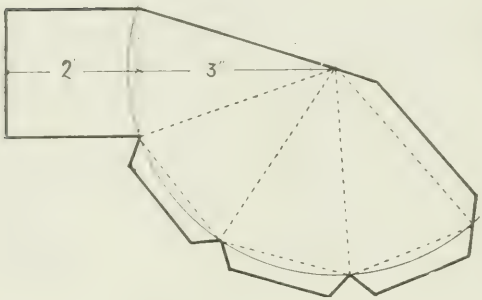
2. *Square Prism, and other Type Solids*:

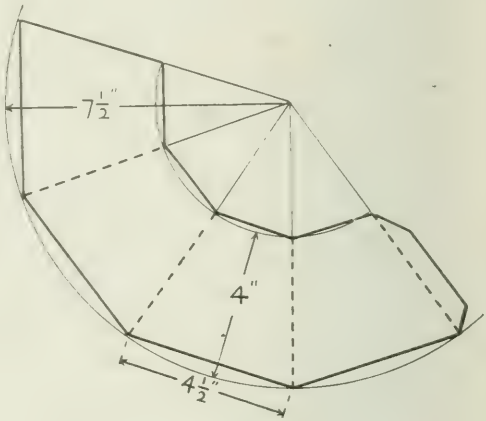




Drawings are shown of the Square Prism, Hexagonal Prism, Square Pyramid, Cylinder, Cone.

In the "stretch-out" of the cylinder the length of the side of the rectangle will be 3 times the diameter of the end. This may be obtained by measurement. The diameter of the end is 2 in., therefore 2 in. x $3\frac{1}{7}$ = $6\frac{2}{7}$ in., which is the length required.

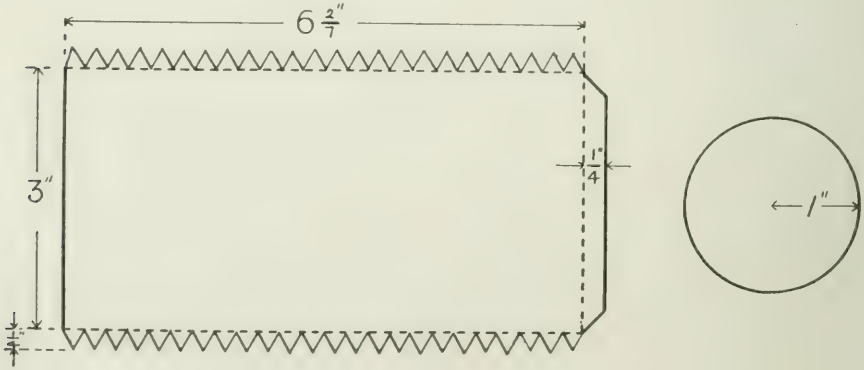


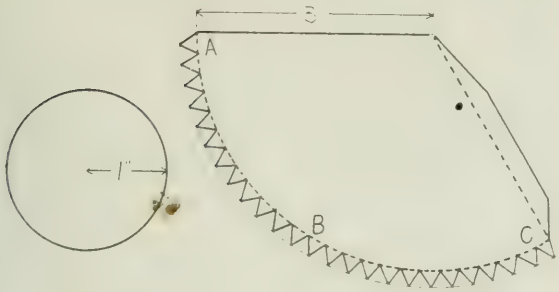


To obtain $\frac{2}{7}$ of an inch, divide a one-inch line into 7 equal parts (Problem 8, page 110), and take 2 of them.

A modification of the square pyramid is shown in the candle shade. A piece of cardboard 10½ in. x 12 in., is required. This exercise allows of considerable decoration. Hexagonal or octagonal shades may also be worked out.

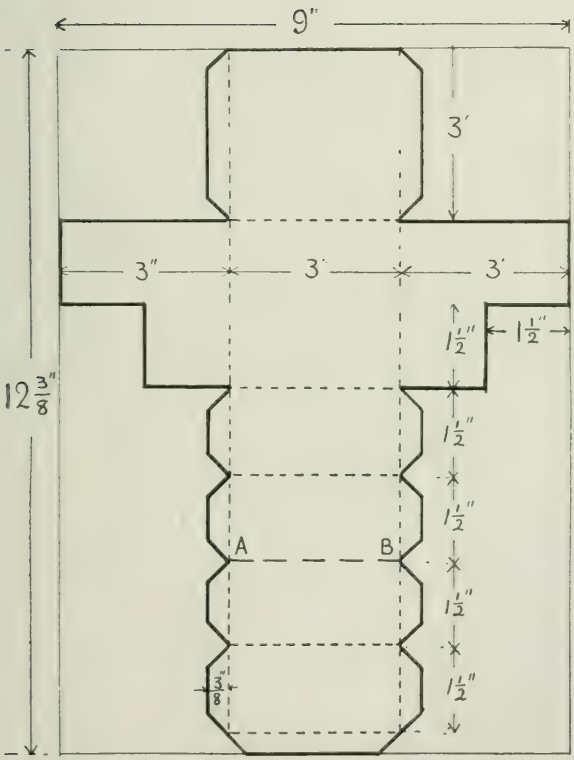
A mechanical method of obtaining the length of the rectangle is to cut out the two circles for the ends and measure the circumference of one of them by wrapping a strip of paper around it. The distance marked on this strip gives the length of the rectangle. Add a pasting flap.

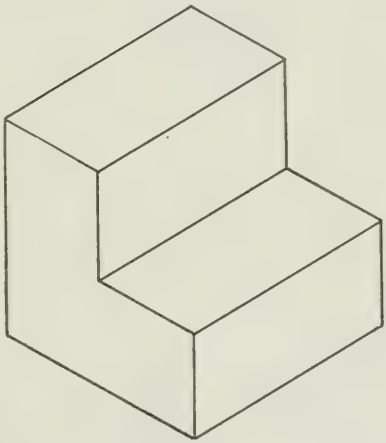




The geometrical construction of the cone will be easily seen from the drawings.

In the cone the arc ABC is equal to the circumference of the circle.





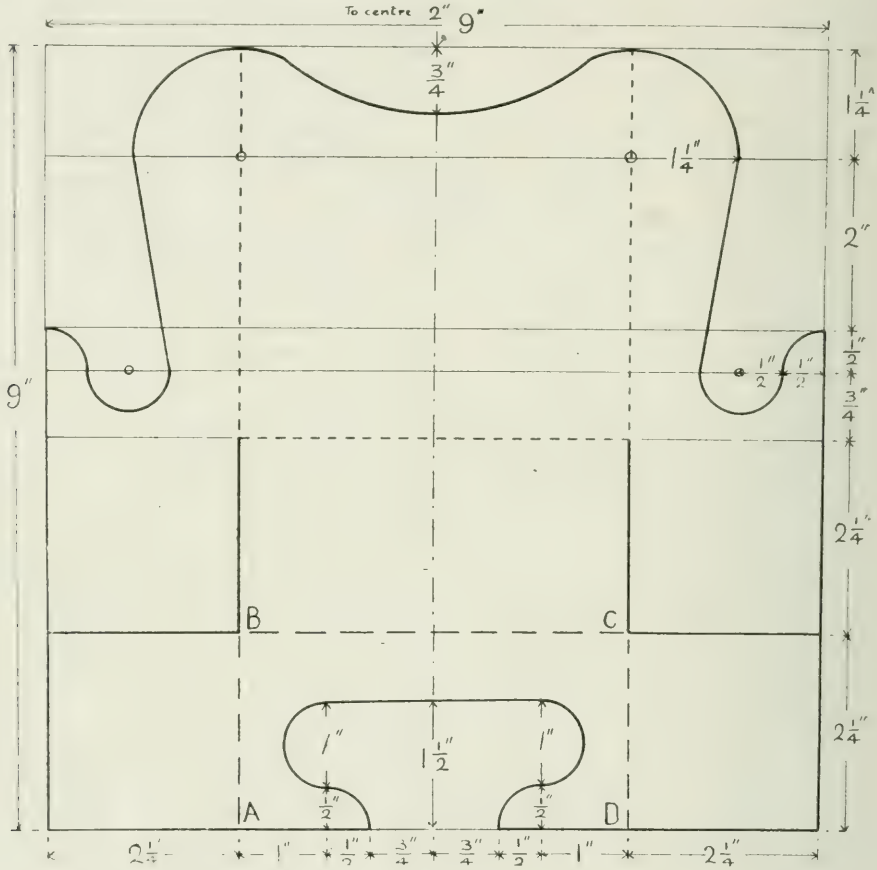
3. *Steps*:

These are shown drawn in two ways; the "stretch-out", and a view of the completed object in what is called isometric projection.

Note that the line AB is scored on the side opposite to the other scored lines.

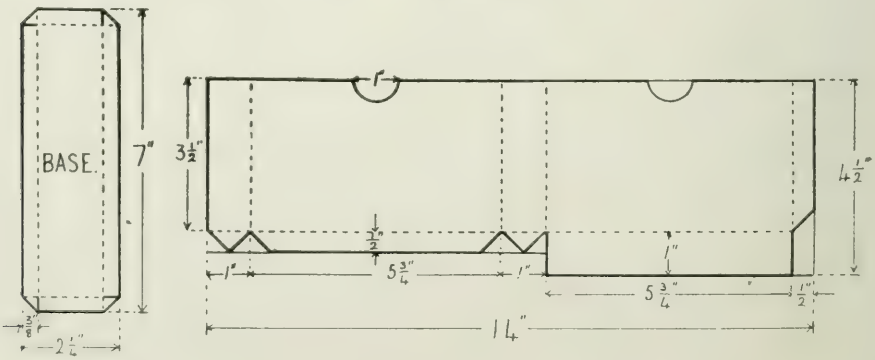
4. *Settle*:

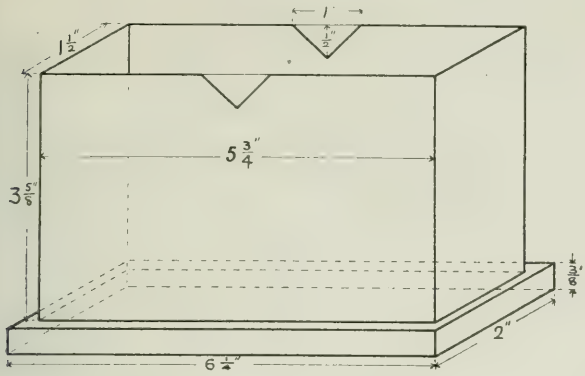
This drawing must be made carefully. The curves may be produced, by the aid of compasses, from centres as shown, or they may be drawn freehand. Lines AB, BC, and CD are scored on the opposite side.



5. *Post-card Box*:

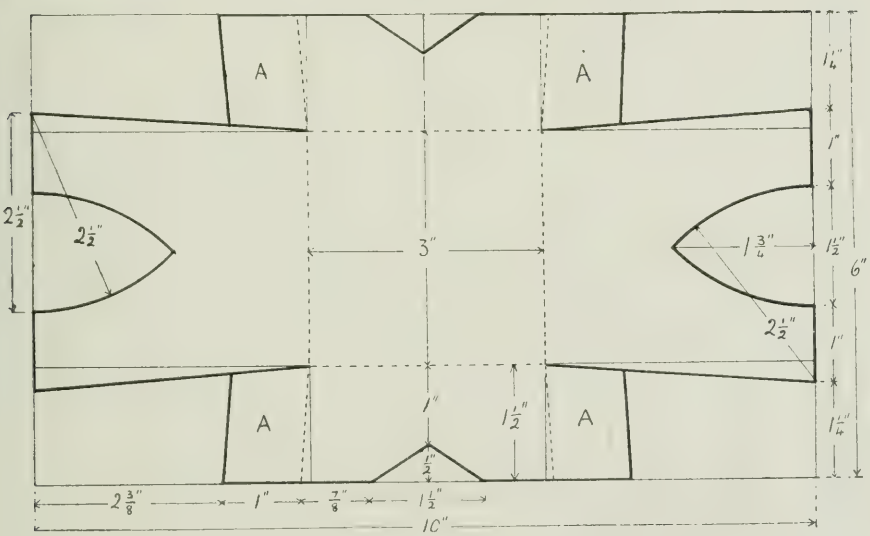
This is drawn in a rectangle 4½ in. x 14 in. The base consists of a shallow inverted tray drawn in a rectangle 2¼ in. x 7 in.

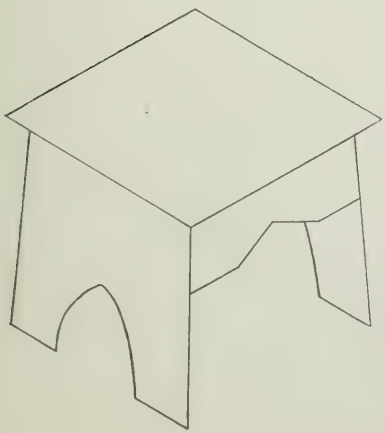




This drawing shows a similar box completed, but with the cut-out portions triangular instead of circular, and different measurements.

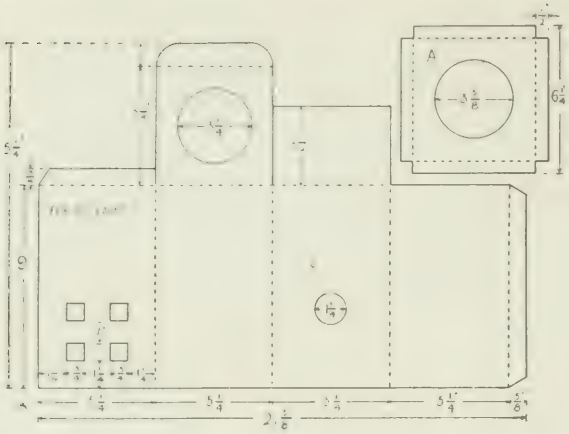
6. *Tabouret*:





Draw a rectangle 6 in. x 10 in. Complete the drawing according to dimensions shown. The pupil will find no difficulty if all measurements are taken accurately.

After cutting to shape and scoring, the flaps marked A are pasted to the legs.



7. *Egg-Candling Appliance*:

This appliance may be used with any ordinary house lamp. In some instances the appliance completely covers the lamp (an ordinary bracket lamp). In other instances it will be found advantageous to cut and use the separate piece of cardboard, by placing it horizontally across the bowl of the lamp and then setting the box upon it in such a manner as to allow the chimney to project through the hole in the lid. It is important that the hole in the front should be on a line with the flame.

This appliance may be obtained free upon application to the Live Stock Commissioner, Ottawa, but it is a very interesting object to make.

8. *Covering*:

Many models are very much improved by being covered with fancy paper. The pattern of these papers should be carefully chosen. Some end papers used by bookbinders are very suitable for this covering. Paper with a small pattern should always be chosen. For a first exercise in covering, take a small square of cardboard (4 in. x 4 in.). Cut a square of the covering paper (5 in. x 5 in.). Place it on the desk, pattern downward, with the cardboard in the centre. Fold the paper over sharply to the edges of the cardboard. Open out, and note the creases. Cut corners as shown in the portfolio. Paste the paper. Place the cardboard in position as before, and rub down. Examine for air bubbles, fold edges over, and complete rubbing down. (Use a sheet of clean paper over the model whilst rubbing, in order to prevent the paper from stretching.)

Cut another square of fancy paper ¼ in. smaller than the cardboard. This will leave a margin of ⅛ in. all round. Paste, and place in position. Rub down as before.

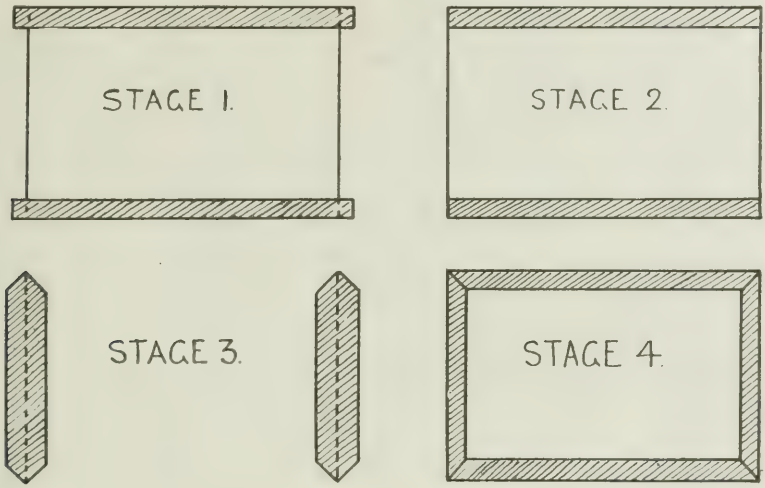
Such mats may be used for calendar or picture mounts, and for various other purposes.

9. *Binding*:

Before actually binding the edges of a model, a little preliminary practice is required. A suitable object for this purpose is a piece of cardboard intended to be used as a picture mount. Binding strips should be half an inch wide, and may be purchased, or may be cut from coloured paper or bookbinders' cloth.

Suppose the cardboard be rectangular, cut two strips slightly longer than the long sides of the cardboard and two exactly the length of the short sides. Fold the strips lengthwise down the centre. Open out and paste. Place the edge of the cardboard in the crease formed by the folding. Press into position as shown in Stage 1. Trim as shown in Stage 2. Mitre as shown in Stage 3. Place the strips in position, and, if they fit, paste and apply as in Stage 4. This method is sometimes followed in framing small pictures and is known as "passe-partout" binding.

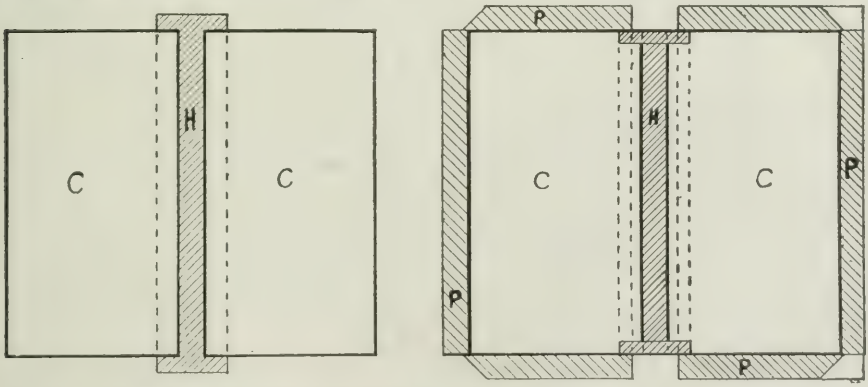
When a model is to be both bound and covered, the binding should be done first, and the covering applied so as to leave not more than ⅛ in. of the binding showing.



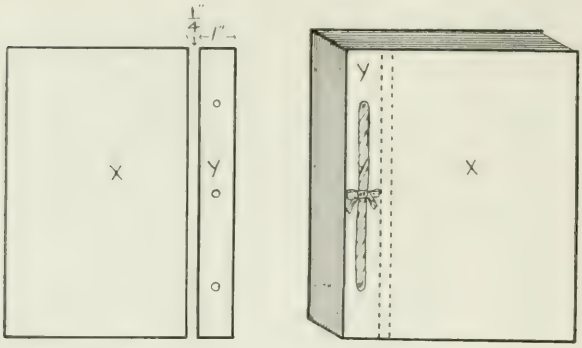
10. *Book Covers and Portfolios*:

Book covers may be made in every form, varying only in difficulty of execution and perfection of decoration.

The following is a description of the figure below. C and C are two pieces of cardboard of the size required. H is a strip of bookbinders' cloth, linen, or buckram, to form a hinge. P in the second figure represents the material with which the outside of the folio is covered. It is shown in position ready for folding over the



edges. The inside of the hinge should be covered with a strip of cloth of the same width as the outside, but ¼ in. shorter than the length of the cardboard. Be careful to press the two pieces of cloth forming the hinge well together, and rub along the inside edges of the cardboard with the thumb nail or a bone folder. The inside of each board may be covered with any suitable material of a size sufficient to leave ⅛ in. margin on three sides. A portfolio with a flap is formed by adding a piece of cardboard to the free edge of C, making another hinge as at H. This flap should be about half the width of C.

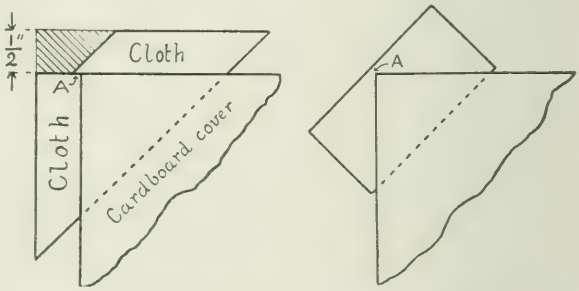


11. *Cover for Loose Sheets*:

This is a modification of the previous exercise. It consists of four pieces of cardboard (two of which are shown) hinged together in pairs by the method before described. Three holes are punched. The leaves to be fastened together are punched in corresponding positions. If a piece of cardboard the size of the smaller pieces be punched in the same manner, it may afterwards be used as a templet to ensure that all future holes be in the same position.

By pasting cloth of sufficient width for a hinge, as shown in the portfolio, these books may be used for containing photographs the mounts of which are punched to correspond with the holes in the covers. The whole is then laced together, and fresh photographs can be inserted when required. The holes may be strengthened by the insertion of eyelets.

12. *Corner Pieces*:



It is often necessary in making folios to strengthen the corners with leather or cloth. This is done in the following manner:

From a square of cloth (say 3 in.) cut along the diagonal. This will give two corners. Paste the cloth and place in the position shown in the drawing. Cut out the shaded portion. Fold over, the mitred corner last, and be careful to make close contact between the cloth and the edge of the board.

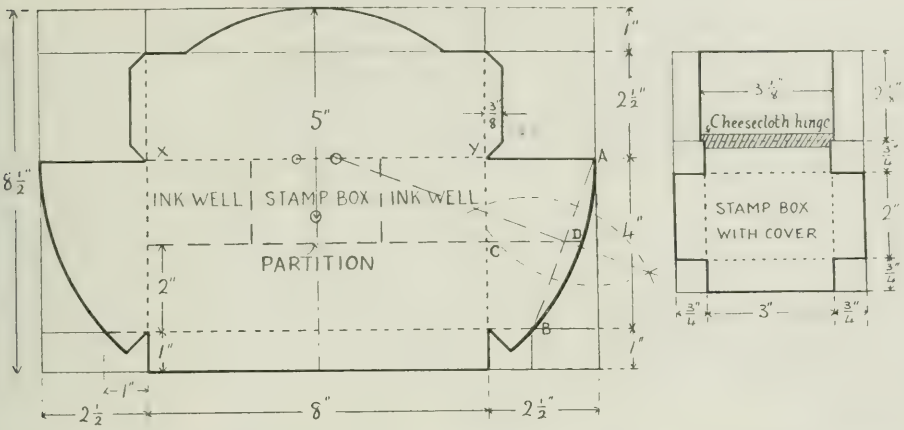
Another method is to take a rectangular piece of the material used, paste, and place in position as shown in the second drawing. Fold sharply over, and see that the edges of the material meet on the inside of the cover. Note space A which is equal to the thickness of the cardboard.

13. *Pen and Ink Tray*:

Construct a rectangle 8½ in. x 13 in. On each end set off distances 1 in., 2 in., 2 in., 2½ in.: and join these points by light lines. On the base line set off distances of 2½ in., 4 in., 4 in.; and from these erect perpendiculars.

The curves of the back and sides may be designed by the pupils. The centres of those given are shown.

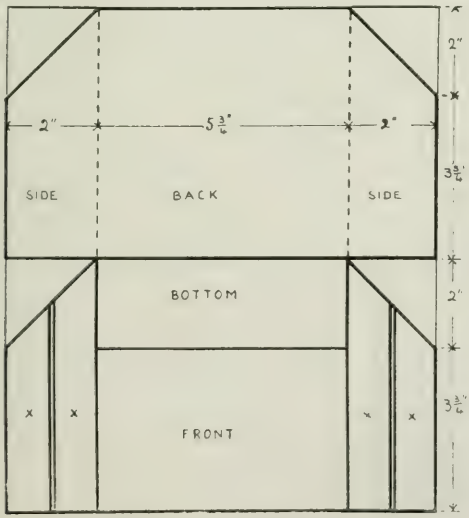
The height of the partition is determined by the length of CD. It may be fixed in position by narrow strips of linen or cloth glued into each angle.

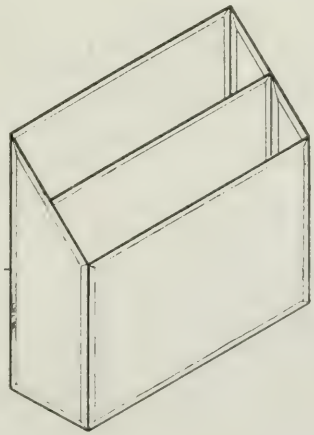


The corners of the stamp box should be glued together by strips of linen. The whole model is considerably improved by being bound and covered.

14. *Stationery Box*:

Construct a rectangle 9¾ in. x 11½ in. Complete the drawing as shown. The pieces marked X are glued to the sides to form a groove for the centre partition.





The picture of this model gives its appearance when bound with strips of cloth. After binding it may be covered if desired.

SIMPLE REPAIRS TO DAMAGED BOOKS

The life of many books can be prolonged through a little timely attention. Loose leaves should be carefully trimmed along the front edge and have the back pasted for ⅛-in. along its length, using a paper guard to prevent the paste spreading. The pasted leaf should be carefully inserted in position, and the book closed until dry. Torn leaves may be mended by pasting gummed strips of transparent paper on each side of the tear, care being taken to bring the torn edges as close together as possible.

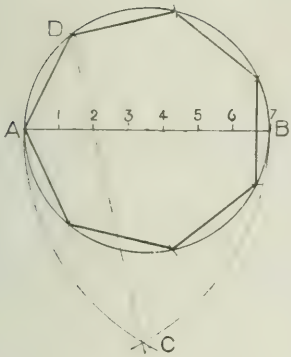
The cover of a book that is badly torn may be repaired by covering with bookbinders' cloth, as shown in the making of portfolios. If the old cloth can be stripped before this is done, it will be an advantage. After covering in this way, take two sheets of paper, fold down the centre, and trim to the size of the leaves of the book. Paste one half of each sheet to the inside of each cover.

A book that has fallen to pieces should be taken carefully apart and restitched either on tapes or on cords, as described in the reference books on bookbinding.

In those cases where the stitching remains intact and the back has fallen away, carefully paste a strip of cheesecloth on the back of the book, rubbing well down. This should be ¼ in. less than the length of the book, thus leaving ⅛ in. at each end. Paste this cloth and replace the original cloth back, rubbing well down. Over the whole, paste a piece of bookbinders' cloth sufficiently large to extend at least 1 in. over each board.

MECHANICAL DRAWING

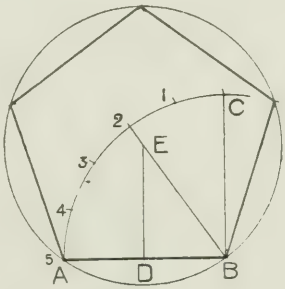
GEOMETRICAL PROBLEMS



To inscribe any regular polygon in a circle:

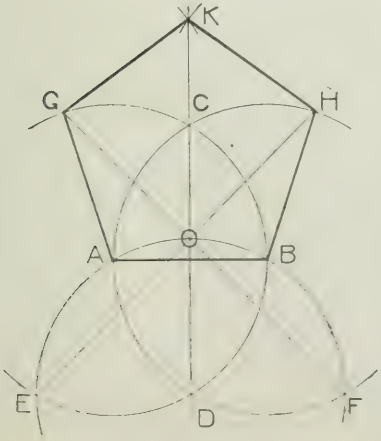
General Method: Draw the diameter AB and divide it into as many parts as the required figure has sides—in this case, seven. With A as centre, and AB as radius, describe an arc BC, then with B as centre, and with same radius, describe another arc intersecting the former at C. From C draw a line through the second division until it meets the circumference of the circle at D; then AD is one side of the polygon. Mark off the remaining sides round the circumference. This will give the figure required.

To describe any regular polygon on a given line:



General Method: Let AB be the given line. At B erect a perpendicular BC equal to AB. With B as centre, and BA as radius, describe an arc AC. Divide this arc into as many equal parts as the required polygon is to have sides—in this case, five. Draw a line from B to the second division. Bisect AB in D and from D erect a perpendicular to cut B2 in E. From centre E with radius EB, describe a circle. Mark off distance AB around it, join the points, and the required polygon is described.

NOTE:—In both these problems the line is always drawn to the second division, however many sides the polygon may have.



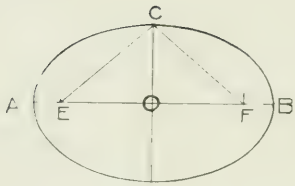
To describe a regular pentagon on a given side AB:

Special Method: With A as centre, and AB as radius, describe circle CBDE, and with B as centre, and same radius, describe circle CADF; with D as centre, and same radius, describe arc EABF; join DC intersecting arc EABF at O. Through O draw lines FOG and EOH. Join AG and BH. With G and H as centres and AB as radius, describe arcs intersecting at K. Join GK and HK. ABHKG will be the required pentagon.

To construct an ellipse, the two axes AB and CD being given: (By the method of trammelling)

Take a strip of paper and set off upon it the distance FH equal to half the major axis, and the distance FG equal to half the minor axis.

By keeping the point G on the major axis and the point H on the minor axis, the point F will give a point of the ellipse. In this manner a succession of points is found. A curve drawn through these points will give the required ellipse.

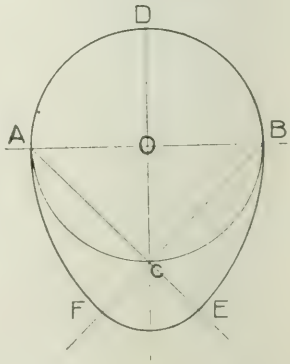


To draw an ellipse with pins and string:

Let AB and CD be the given axes intersecting at O. With D as centre, and OB (that is, half the major axis) as radius, set off points E and F on the major axis. These are the foci of the ellipse.

Insert pins at E and F and fasten a string to them, the length of which is equal to EC plus CF. Insert the pencil point at C in the loop formed by the string and draw the ellipse.

NOTE:—An ellipse has two foci, and the sum of the radii from these two points is always equal.



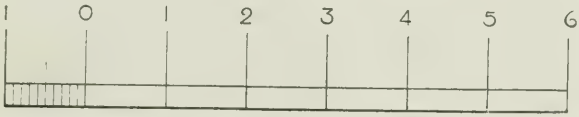
To construct an oval having a given width:

Let AB be the given width. Bisect AB in O and with centre O, and radius OB, describe the circle ABC; draw diameter DC at right angles to AB. Through the point C draw the lines BC and AC; with A and B as centres, and AB as radius, draw the arcs BE and AF. With C as centre, and CF as radius, draw arc FE, thus completing the oval.

Metric Scale:

This scale is based on the metre, which is equal to 39.37079 inches.

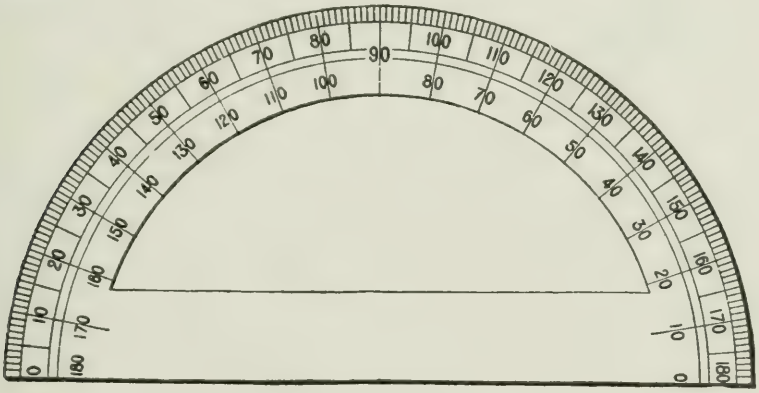
The metre is divided into 100 equal parts called centimetres, seven of which are shown in the Figure.



The centimetre is divided into ten equal parts called millimetres. This is a very simple scale, from which even young pupils can obtain very fine measurements without having any difficult calculations to make in fractions, which would be the case if the English scale were used.

The 0 corresponds to the decimal point in the decimal notation.

Protractor:

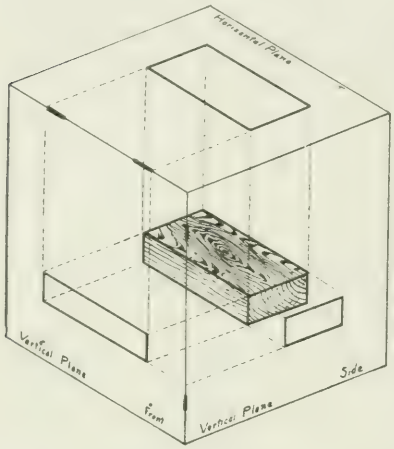


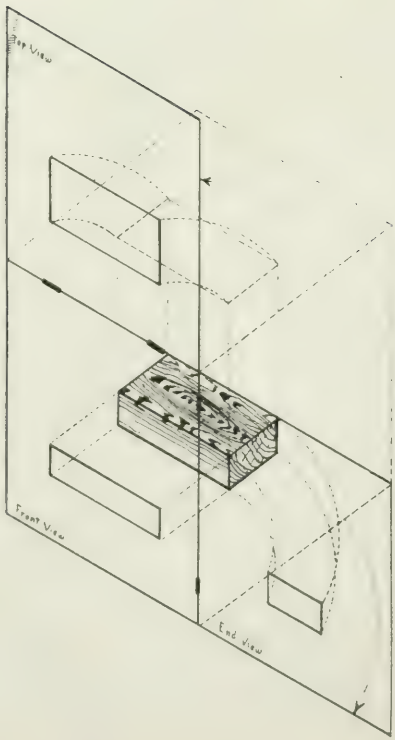
A protractor is an instrument used for measuring or setting off angles; it may be either semicircular or rectangular in shape.

The centre of the base line is the point from which the radiating lines are drawn and corresponds with the centre of the circle. The degrees are numbered in primary divisions, equal to ten degrees each, on the outside line from the left, and on the inside line from the right. These primary divisions are subdivided into ten secondary divisions, each of which represents one degree.

PLANS AND ELEVATIONS

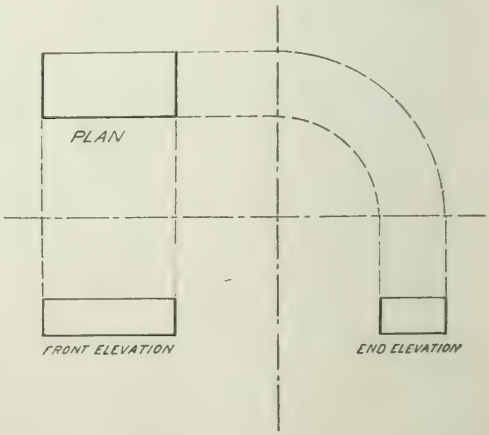
In Form III the method of obtaining the front view (front elevation), the top view (plan), and the end view (end elevation), of any simple object such as a cube has been shown. The object was viewed through a sheet of glass placed in front, above, and opposite the end of the object, and the appearance of the surface of the object projected on to the glass gave the view required. The instruction already given (pages 120-122) should be reviewed and extended. The panes of glass are now combined to form a transparent hollow cage in which the object to be drawn is placed. The sides of this cage are hinged, so that it may be opened out flat.





Place inside this cage a brick of wood, and sketch on the front plane the front elevation, on the top of the glass the plan, and on the end the end elevation. The dotted lines in the Figure show exactly how the points are obtained. Let the pupils trace each line from the point of the object to the same point represented on the glass plate. Small dowel rods or strips of wood may be used to represent the dotted lines. Place objects of different shape inside the cage and proceed in the same way. A few such objects treated in this manner will make the principle quite clear.

It now remains to show how the views obtained on the glass plates are actually represented on a sheet of paper. The panes of glass are revolved in the direction of the arrows until they are flat and in the same plane. The positions they now occupy show the correct position of the drawings. Revolve the panes of glass with drawings of different figures, as in the previous case. In place of the glass cage some teachers use a cage the sides of which are formed of very fine screen wire. This can be drawn upon with chalk more easily than the glass.



Of course, in actual practice, the cage is not used; but the different views are always supposed to be projected on to a transparent plane.

The appearance of the finished drawing, showing the three views we have obtained by the use of the cage is shown below.

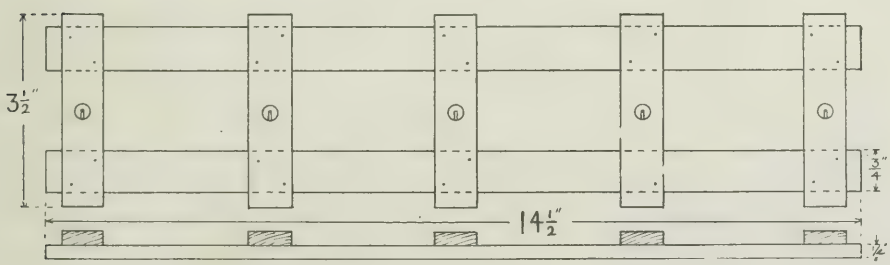
WORK IN THIN WOOD

The work in thin wood suggested for Form III may be continued with advantage in those schools that are not provided with bench equipment. In this Form the work will be of a more advanced character, the principles of construction adopted in the industries being introduced in an elementary way. Much greater stress should be laid on the mechanical drawing. All the work given in this section may be done on the cutting board placed on the desk and without special bench equipment. The chapter on "Rural School Bench Work" will provide working material for those schools that are properly equipped with tools and benches.

When given the opportunity, boys will do work of various kinds without much definite instruction. Much work has been done during recess and out of school hours. Boys can be induced by suggestions to undertake many minor repairs in the school and around the grounds, such as mending fences, repairing latches, putting in a broken window-pane, making garden seats, window-boxes, tool racks, etc.

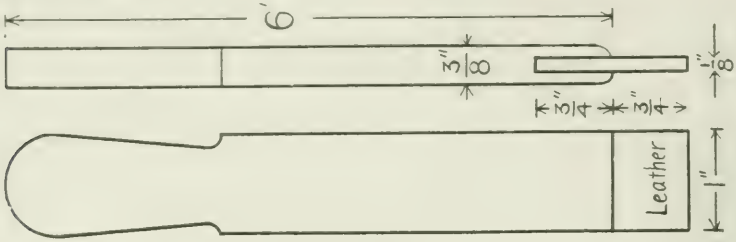
Their attention should be directed to articles in various magazines and books dealing with "How to make things". As the different materials are used, the pupils should study brads, screws, and glue; the timber with its characteristics and uses; the trees from which the wood is obtained; and the processes through which the lumber passes before reaching our hands. The pupils should make collections of leaves of the typical lumber-bearing trees, also pictures of the lumber industry, and of trees at different seasons of the year.

1. *Key Rack*:

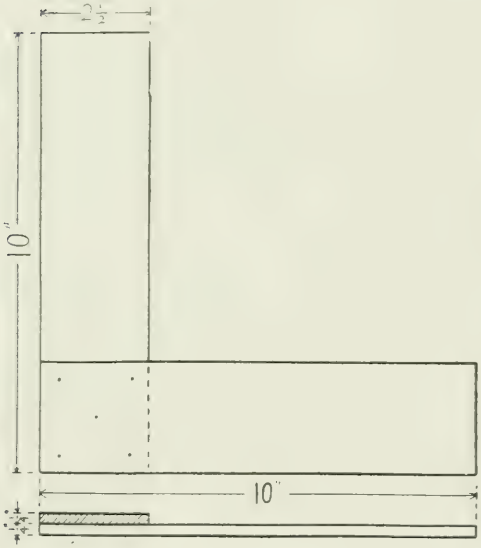


This is made from strips ¾ in. wide x ¼ in. thick. The wood should be surfaced on two sides. Cut two pieces 14½ in. long and five pieces 3½ in. long. Nail as shown. Small cup hooks are screwed in the centre of the cross-pieces. At the top of the end cross-pieces place small screw hooks for hanging.

2. *Glue Spreader*:



This is a useful article for spreading glue on small surfaces. Cut to the width required and set out and shape the handle. Saw the small groove and cut out with a pen-knife. Insert the leather, which should be fairly stiff and not very pliable, and tack through with small brads.

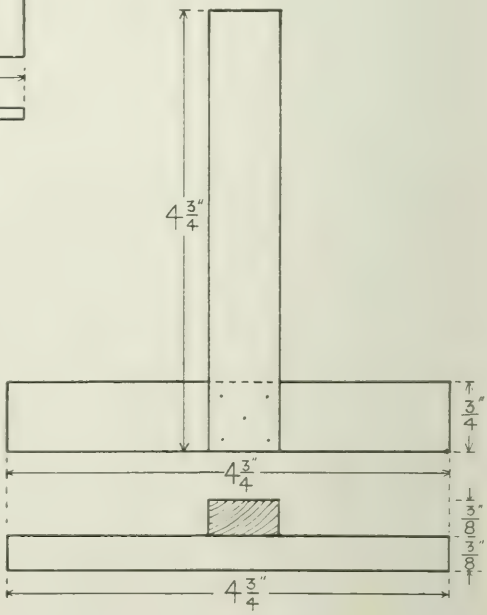


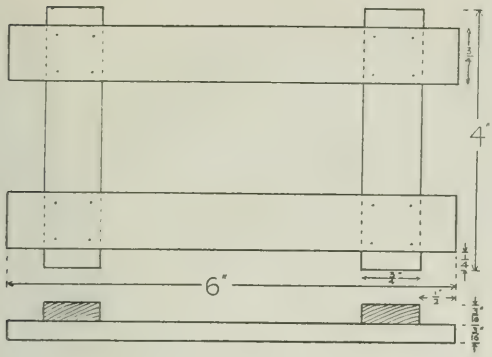
3. *Boomerang*:

Saw to the length required. Set out the width and cut to lines, finishing the edges with sand-paper if necessary. Fix centre nail and test the angle, which should be a perfect right angle. Drive the other nails when correct.

4. *String Winder*:

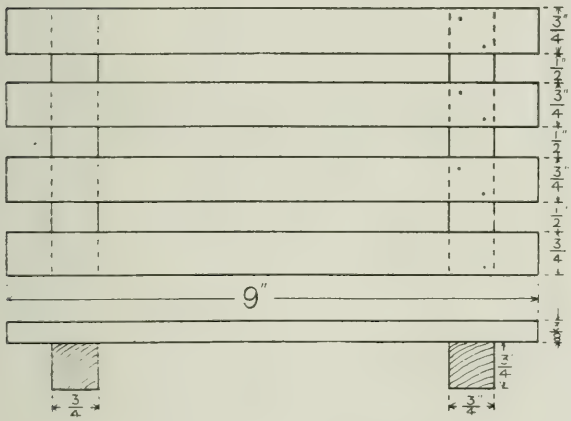
Two pieces are required, each 4¾ in. long. Set out the place for the upright exactly in the centre of the horizontal piece. Fix the centre nail. Test with square and drive the remaining nails.





5. *Fish-line Winder*:

Cut two pieces 6 in. long and two pieces 4 in. long. Square lines ½ in. from each end of the long pieces and ¼ in. from each end of the short pieces. Place in correct position and nail, being careful that all angles are right angles.

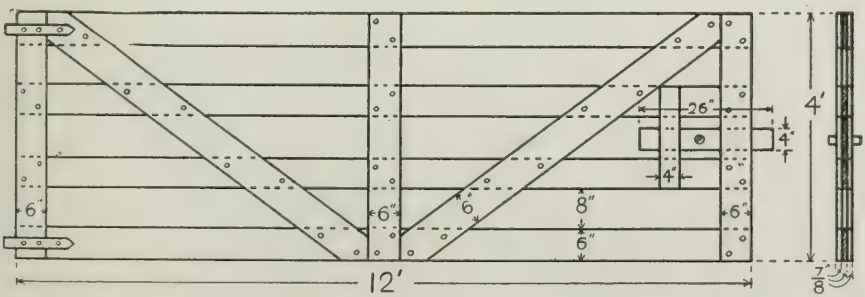


6. *Plant Pot Stand*:

Cut four strips 9 in. long. Calculate the length of the two short strips. On the longer strips, square lines showing the positions of the shorter strips. Nail, being careful to see that the spaces between are equal. A strip of wood ½-in. wide is useful as a gauge for the width of the spaces.

7. *Gate*:

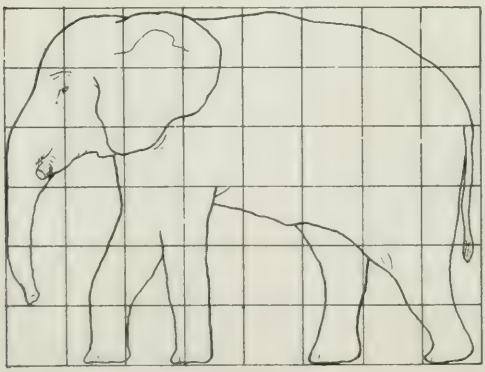
The dimensions given on the drawing call for a full-size gate. A model of this, 12 in. long, may be made by reducing all length and width measurements to a scale of 1 in. to 1 ft., and using strips 3/16 in. thick.



COPING-SAW WORK

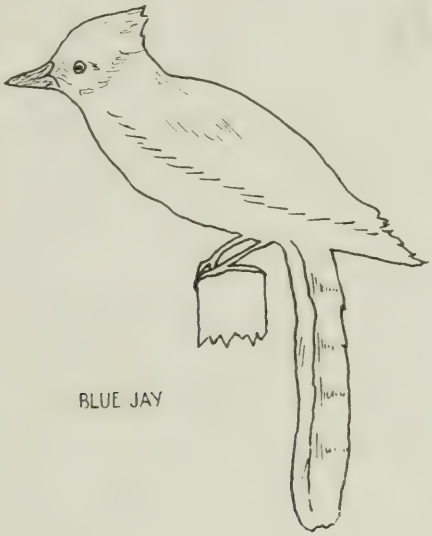
Plate 32—Coping-saw work.

Work with the coping-saw provides a useful medium for work in wood, with very little equipment. The tools supplied for this work are the same as those used for strip work, with the addition of the coping-saw and extra blades. Pupils should be encouraged to provide their own saws. In the Ottawa schools, experience has shown that it is not necessary to provide a G-clamp to hold the work while sawing. In some cases a pattern is provided for the pupils to trace; but it is much better practice to teach them to draw their own patterns from copies and observation. The painting and decoration of the finished work may be done at home or in the school. In the latter case, it is perhaps better left till the end of the term and done all at once, with a plentiful supply of newspapers to protect the desks, etc. The various colours of household paint may be used, or specially prepared enamels can be obtained. Small cans should be used. Shoe-polish tins after a thorough cleaning, have in some cases been made to serve, and they answer very well, and also avoid the tragedy of an overturned can of paint.



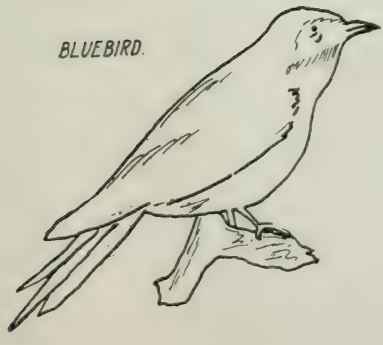
This figure shows how the drawing of an animal, bird, etc., may be enlarged or reduced for coping-saw pieces. By enlarging or reducing the squares, an enlargement or reduction of any size may be made.

The teacher should make a collection of these patterns. They may be traced on cardboard and cut out and coloured by the younger pupils. They provide excellent material for seat or "busy" work. After being cut the models should be mounted on stands. The illustrations on the following pages show many examples of this kind of work, which has all been developed in the Ottawa Public Schools.

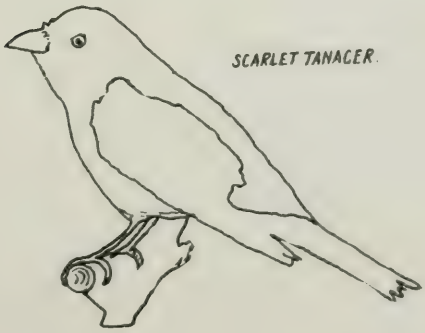


BLUE JAY

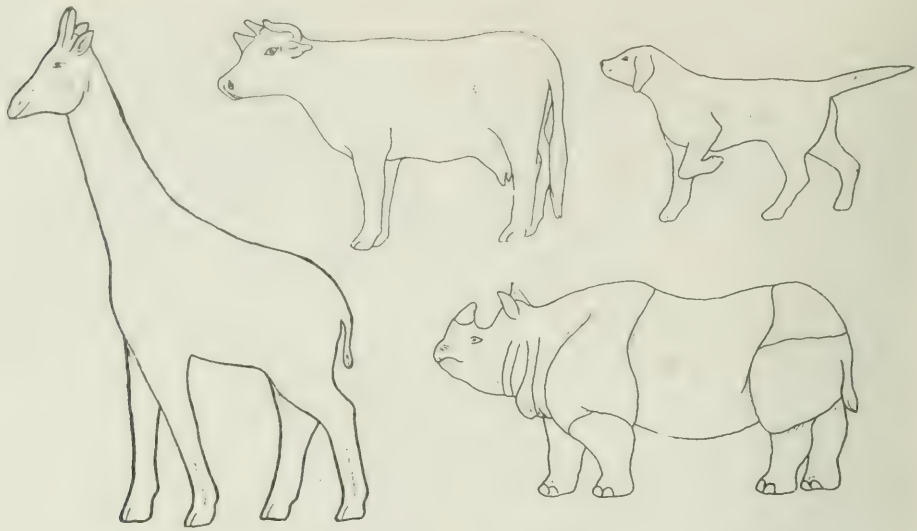
ROBIN.



BLUEBIRD.



SCARLET TANAGER.



SUGGESTIONS FOR COLOURING BIRDS

Blue-bird: Upper parts, wings and tail—bright blue. Throat, breast, and sides—cinnamon red. Underneath—white.

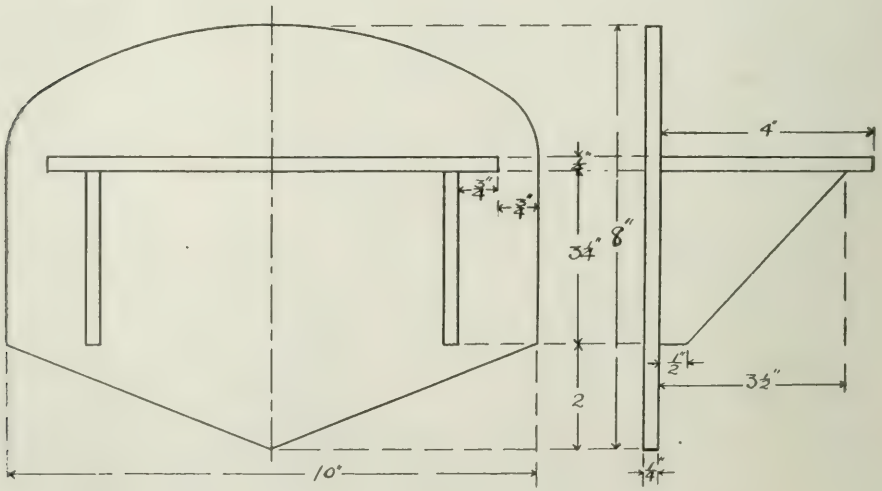
Scarlet Tanager: Brilliant scarlet, with black wings and tail. Bill—black.

Robin: Dull brownish, olive gray above. Head—black, tail—brownish black, with exterior feathers white at inner tips. Wings—dark brown. Throat—streaked with black and white. Entire breast—dusty red, whitish below tail.

Blue Jay: Blue above. Black band around the neck, joining black feathers on the back. Under parts—dusky white. White coverts; tail—bright blue, striped across with black. Tail—rounded. Many feathers and tail edged with white. Head—crested. Bill and legs—black.

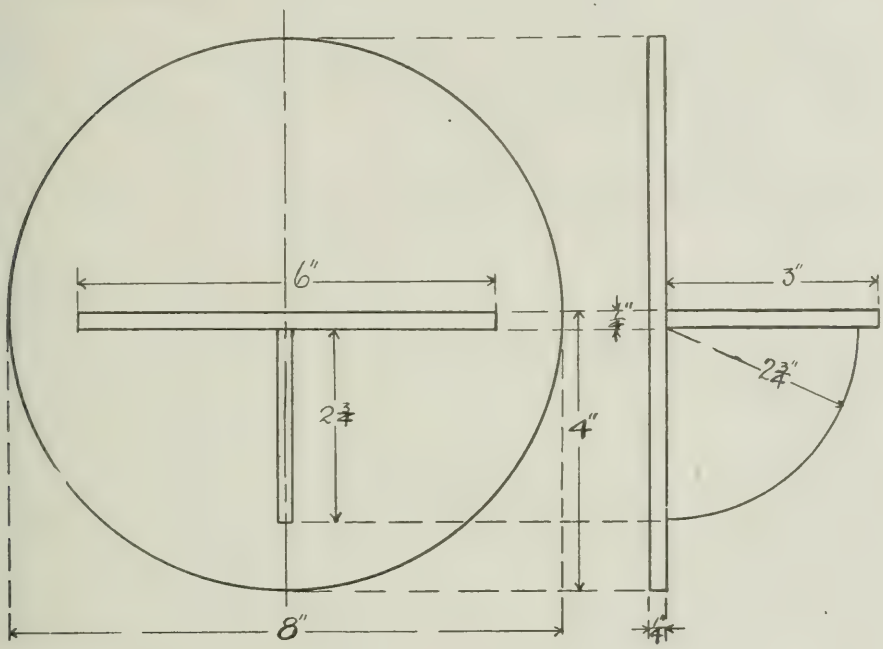
A few useful and typical exercises of other models in thin wood-work are given below.

1. *Shelf*:



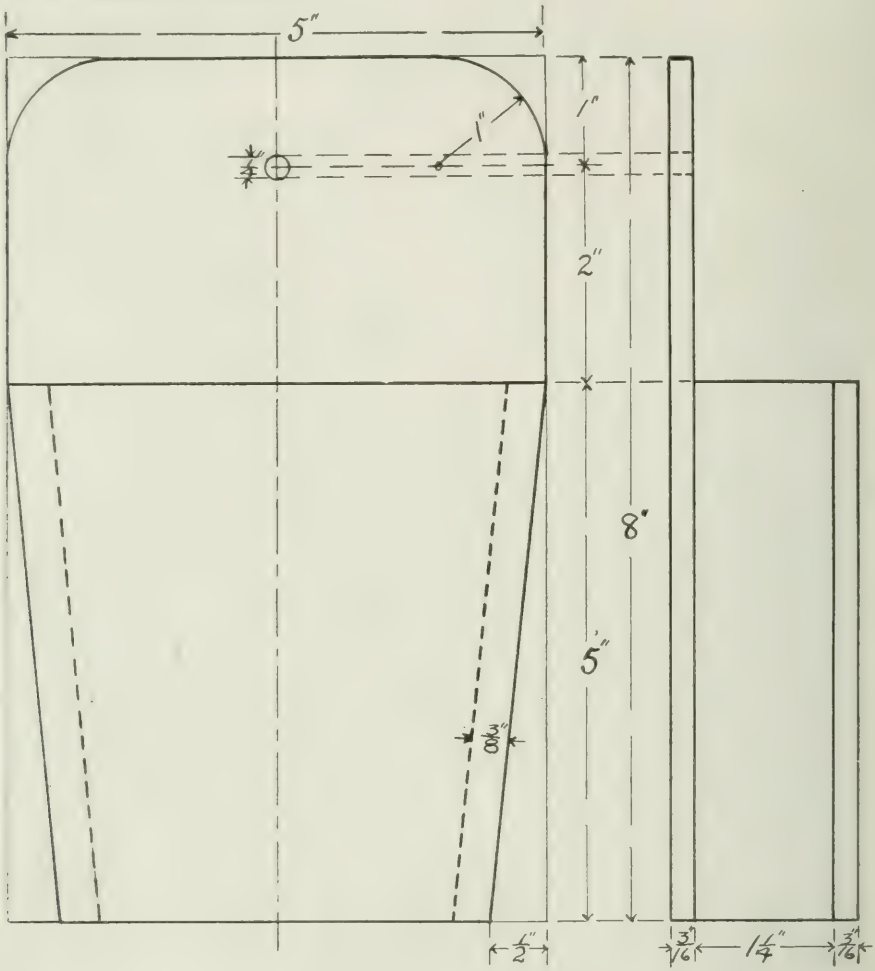
Two views are given—front and side elevations. A shelf may be designed by the pupil for his individual use. The one shown consists of four parts—back, shelf, and two supporting brackets. A piece for the back may be selected, and the desired design drawn. The shape of the supports may be modified, care being taken that the angle between the shelf and the back is a right angle. The parts are fastened together with glue and fine brads; very fine screws may be used.

2. *Clock Shelf*:



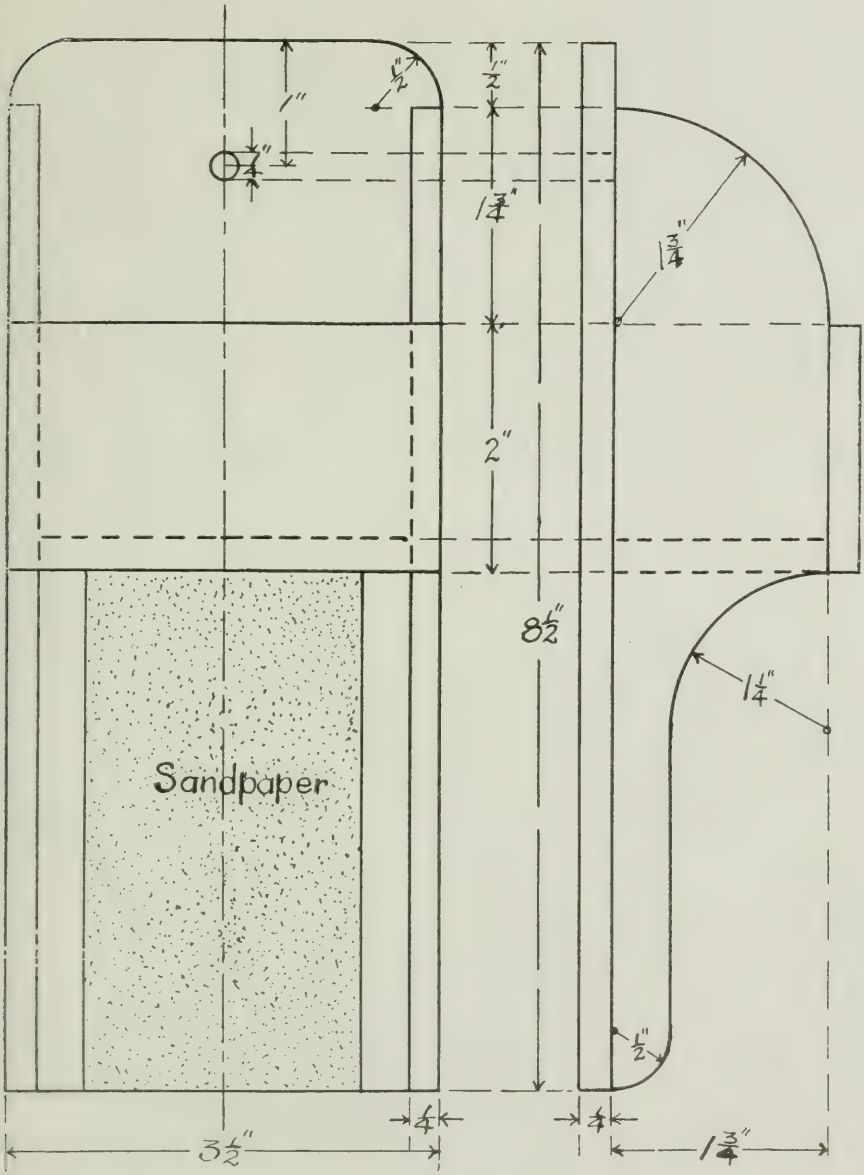
Cut an 8-in. circle for back. For shelf and bracket cut a 6-in circle. One half of this forms the shelf. Half the remainder cut to a radius of 2¾ in. forms the support.

3. *Whisk-broom Holder*:



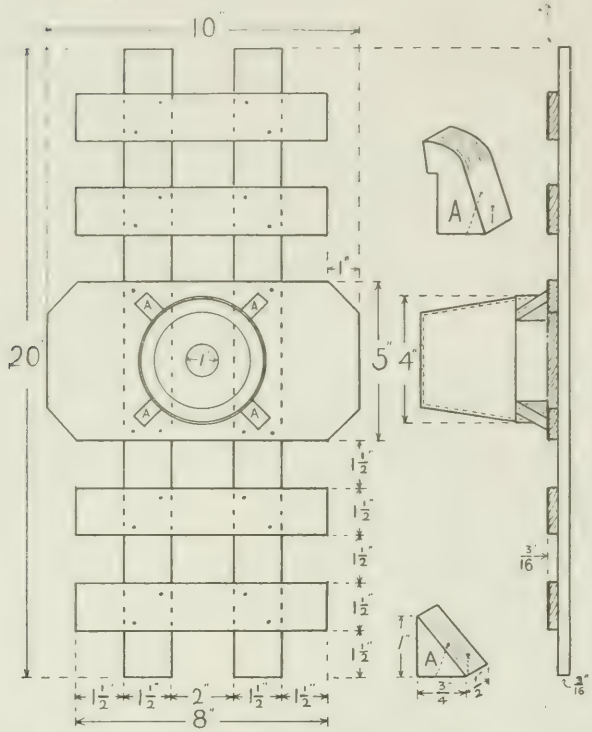
For the back, make the drawing as shown on a centre line. Cut to the lines with a knife. In a similar way set out and cut the front. Cut the sides to the desired shape. Nail the back and front to the sides with brads 3/4 in. apart, and sink the heads a little below the surface of the wood.

4. *Match Safe:*



This model consists of five pieces. Set out the work on one piece of wood according to the sizes shown. Nail together as previously explained. The design of the upper portion of the back may be modified as desired.

5. *Wren-house:*



A bird-house is always an interesting model and can be made from a great variety of materials. The one shown is made from a plant pot. Enlarge the hole in the flower-pot to 1 in. in diameter with a round or half-round file. AA are brackets to hold the flower-pot in place. They are cut to fit the style and size of the pot used.

A hollow log is best for woodpeckers and flickers. The robin will not use an ordinary bird-house, but must have one with at least an open front; one side open also is better. Martins prefer to live in colonies, and a martin-house should have several compartments, each about 6 cubic inches, and each quite separated or shut off from the others. Below are given particulars of the requirements of houses for various birds.

—	Floor space	Depth	Height of entrance above floor	Diameter of entrance	Height of house above ground
Bluebird	5″ x 5″	8″	6	1½″	5′ to 10′
Robin	6″ x 8″	8″	.....	.....	6′ to 15′
Chickadee	4″ x 4″	8″ to 10″	8	1⅛″	6′ to 15′
Nuthatch	4″ x 4″	8″ to 10″	8	1¼″	12′ to 20′
House Wren	4″ x 4″	4″ to 8″	1″ to 6″	⅞″ to 1⅛″	5′ to 10′
Purple Martin	6″ x 6″	6″	1″	2½	15′ to 20′
Flicker	7″ x 7″	16″ to 18″	16″	2½″	6′ to 20′
Redheaded Woodpecker	6″ x 6″	12″ to 15″	12″	2½″	12′ to 20′
Downy Woodpecker	4″ x 4″	8″ to 10″	8″	1¼″	6′ to 20′

A series of suggestions has been given previously for work in thin wood, known as strip work. These strips should be obtained planed to width and thickness. The articles shown are typical of many that can be made in heavier material when facilities are provided. Wheels may be cut with a centre-bit of the correct size and having its horizontal cutter filed away.

RURAL SCHOOL BENCH WORK

ACCOMMODATIONS

Probably one of the greatest problems in providing bench work for the ordinary rural school is the difficulty of finding space in which to place the benches. Where the school-room is fairly large, it has been found possible to build a bench not exceeding 18 in. in width along one of the walls of the room, allowing about four feet of working space for each pupil.

A dry basement often provides facilities for the installation of benches. In some schools satisfactory benches have been built by the local carpenter across each end.

Other schools have utilized part of a wood-shed or have erected a portable garage in the school grounds. In some cases a bench has been built out-of-doors. Of course, it is only possible to use such a bench in fine weather.

The best provision is a separate room attached to the school building and communicating with the class-room. One two-roomed school in the Province has added a manual-training room and a household-science room to the school building, each communicating with the class-rooms; in this way work can go on while the other classes are at their studies. If this provision is made when the school is erected, the cost, of course, is much less.

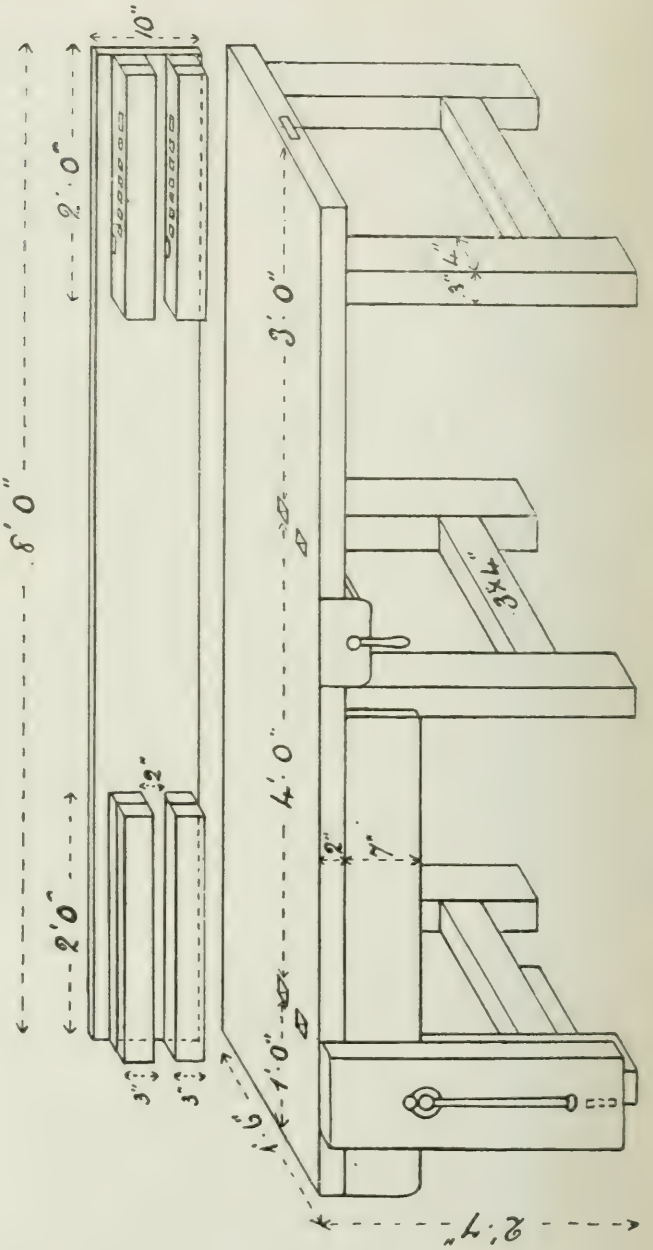
BENCHES

Benches built locally should be provided with as many ordinary carpenter's vices as there will be pupils working at any one time. They should be securely framed together and fixed to the floor, by either bolts, screws, or L brackets, in order that they may be perfectly rigid in action. Cupboards may be built under them if desired, in order to contain the tools when not in use, or a drawer may be provided for each bench. In this case, care should be taken not to allow the drawer to become filled with waste wood and shavings.

A working drawing of a bench built along one wall of a school-room is shown. This can be worked at only when its use will not disturb the remainder of the pupils.

When a separate room large enough to provide accommodation for the number of boys who will be working at any one time can be secured, the problem is much simplified. If desired, single or double benches may be purchased. These should be well and strongly made, rigid and stable, and of well-seasoned maple throughout, or at least with tops of that material. The top should not be of one piece. It is better made of strips joined or dowelled together and should be bolted to the frame, as adjustable benches with movable tops are seldom satisfactory. If the benches are provided with tool racks, the cutting edges of the tools should be properly guarded and the handles should project as little as possible above the tops of the benches.

BENCH, FIXED TO THE WALL OF CLASS ROOM, FOR TWO PUPILS. THIS MAY BE TAKEN AS REPRESENTING TWO UNITS, WHICH MAY BE INCREASED INDEFINITELY, ACCORDING TO THE SPACE AVAILABLE.



TOOLS REQUIRED

The following tools will be required for each boy working at one time:

bench hook (see page 192),
jack-plane (Stanley No. 5),
back-saw—12.,
marking gauge,
rule—1 foot.
3 firmer chisels—1 in., ½ in., ¼ in.,
pencil compass,
6 in. try-square,
knife.

GENERAL TOOLS

1 wood countersink,
1 pair of wing dividers,
1 crosscut-saw, 22 in.,
1 oil-stone,
1 8-in. swing brace,
2 nail sets,
1 screw-driver, 10 in.,
3 mortise chisels, 1 in., ½ in., ¼ in.,
4 brad-awls (assorted),
1 pad or keyhole-saw,
1 rip-saw, 22 in.,
1 12-in. try-square,
1 set of auger bits in eights, ¼ in. to 1 in.,
1 pair of cutting pliers,
1 monkey-wrench,
1 turning or bow-saw,
1 marking gauge,
1 mallet,
1 oil-can,
1 bevel,
1 screw-driver, 6 in.,
1 glass-cutter.

STORING TOOLS

Proper provision must be made for storing tools when not in use, and especially during holidays. During the school term the bench tools may be kept in racks on the benches. A place should be provided for each tool, so that an empty space indicates a missing tool. The general tools should be kept in a chest or cupboard which the older boys can probably make, or a shelf in the school cupboard may perhaps be utilized.

When tools are stored in a basement and there is the slightest possibility of rust, they should be rubbed with a slightly oiled rag before being put away, and this treatment should be given to all tools before being left for the holidays.

DESCRIPTION OF TOOLS

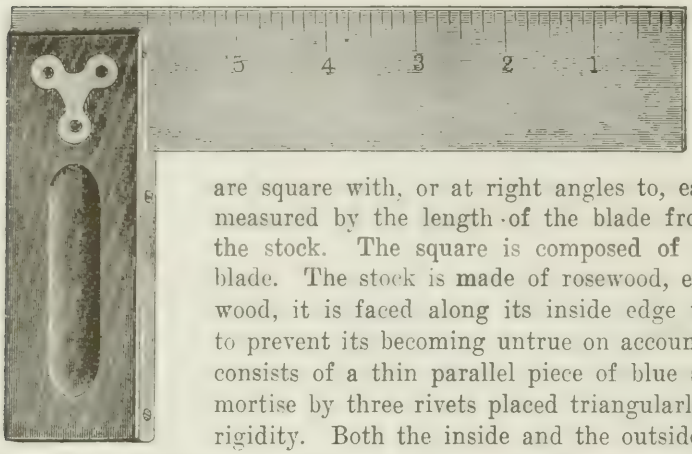
Bench Hook:

The bench hook is very useful to hold work firmly for sawing, planing, and chiselling; it also serves to protect the bench top. It can be made easily by the pupils. It is illustrated and its method of making described on page 192.

The Rule:

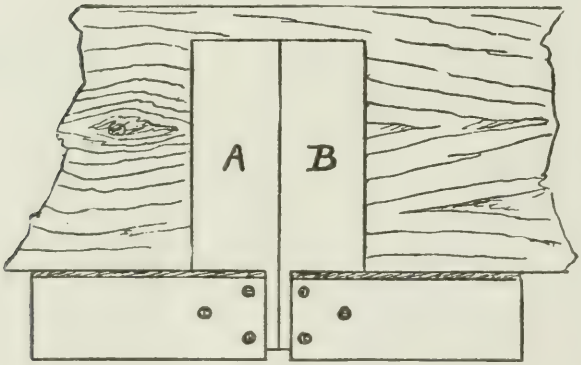
This may be obtained in different patterns. (1) 12-in. foot rule, (2) twofold 2-foot rule, (3) fourfold 2-foot rule. The 12-in. rule generally has bevelled edges, and the folding rules are best with bevelled edges inside. If a rule without bevelled edges is used, it must be turned on edge when marking off distances. As the rule usually is fully ⅛ of an inch thick, error must arise if it is used flat. In spacing off distances the rule should not be moved, but the pupils should be required to sum up the distances as they mark them off.

The Try-square:



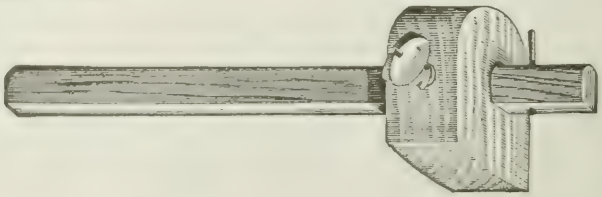
The try-square is used for drawing lines at right angles to an edge and for testing whether two adjacent surfaces are square with, or at right angles to, each other. Its size is measured by the length of the blade from the inside edge of the stock. The square is composed of two parts—stock and blade. The stock is made of rosewood, ebony, or metal. If of wood, it is faced along its inside edge with a strip of brass to prevent its becoming untrue on account of wear. The blade consists of a thin parallel piece of blue steel fixed in an open mortise by three rivets placed triangularly, to give the greatest rigidity. Both the inside and the outside angles of the square should be perfect right angles, though the inside one is the more important of the two.

Testing the Try-square:



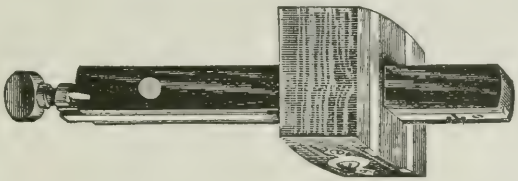
The usual method of testing the try-square is as follows: Take a board the edge of which has been trued up perfectly straight. Place the square in position A and scribe a cut line on the face of the board. Reverse the square to position B and scribe another cut line. If the two coincide, the square may be assumed to be correct. The inside angle may be tested in the same way. If the two lines do not coincide, the error is half the difference between them. Though this test is not absolute, it is exact enough for all practical purposes.

The Marking Gauge:



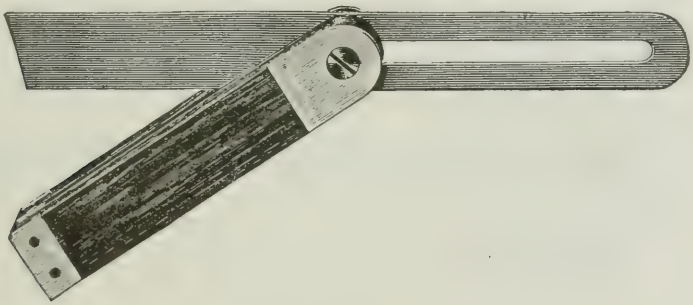
The marking gauge consists of a stock, stem, fixing screw, and steel wire point, or tooth. The stock and stem are usually of beech, and the stock is often

inlaid with two strips of brass on its bearing surface. The stem is movable through the stock, but can be fixed in any desired position by the boxwood screw. The marking gauge is used for setting out width and thickness by scribing lines on flat surfaces, chiefly in the direction of the fibre and parallel to an edge or face against which the stock bears. The gauge is set so that the distance between



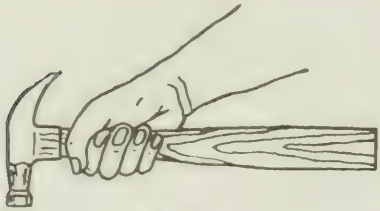
the spur and the stock is the distance at which we wish to make a line from the working face. After setting, it is always advisable to test a second time after tightening, as the end of the screw falling on an old depression on the side of the stem may cause the stock to slip backward or forward, and so alter the distance between the spur and the stock. Other forms of this tool are the cutting gauge, used for cutting across the fibres, and the mortise gauge, which has two spurs, one of which is fixed and the other movable. This is used for gauging the thickness of tenons and the width of the mortise they are to fit.

The Sliding Bevel:



The bevel is used when it is necessary to work at angles different from a right angle. It consists of a stock, generally of rosewood, ebony, or steel, and a thin steel blade. The stock has a narrow slot cut in its length, to receive the blade when not in use. A long slot is cut in the blade, through which a screw in the end of the stock passes, and the blade is pivoted on this screw, the tightening of which binds the blade in any required position. The blade is sometimes fixed by a lever or thumb-screw at the end of the stock, instead of by an ordinary screw. The size of the bevel is measured by the length of the blade.

The Hammer:

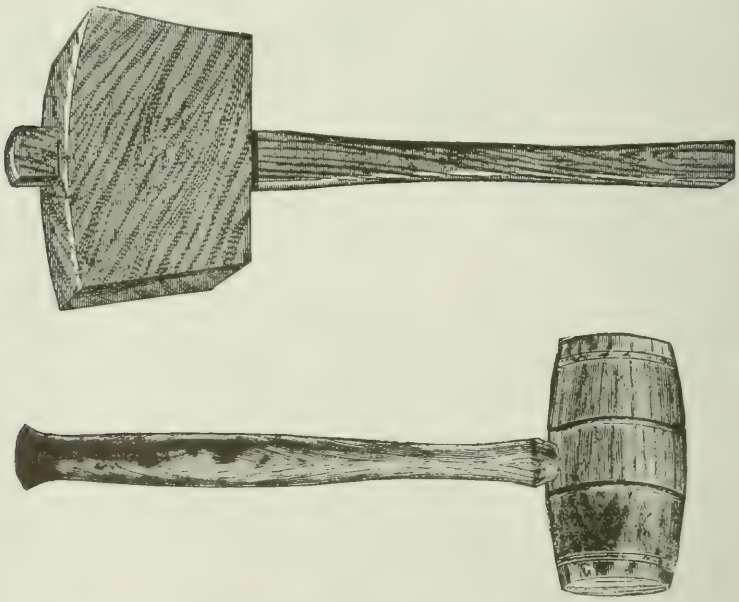


Wrong

Right

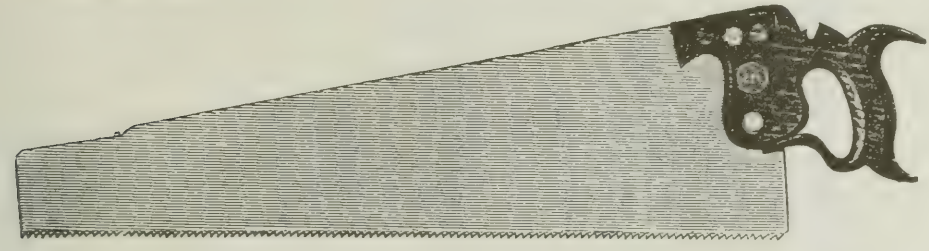
The carpenter's hammer is used principally to drive or withdraw nails. The various trades have hammers made specially for their needs; thus we have machinists', roofers', upholsterers', stonecutters', and other hammers, but the claw-hammer shown is the one generally used by wood-workers. It consists of two parts—the head and the shaft. The head is generally of cast steel. One end, called the face, is used for striking the material, the other end is divided into a claw for withdrawing nails. There is either a round or an oval hole, called the eye, passing through the head to receive the shaft, which is firmly fixed and wedged into the eye. The shaft is made of ash, hickory, beech, lancewood, or rosewood. The number two hammer weighing thirteen ounces is a good size for boys, with a heavier hammer in the general kit for special use.

The Mallet:

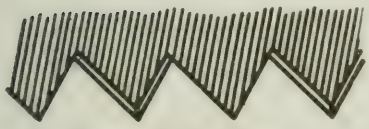


The mallet is simply a hammer made of wood and is used when we wish to strike a blow which shall be less concentrated than that given by the hammer. It is used in certain kinds of heavy chiselling, such as house-framing, and gives a blow which does not damage the handle of the chisel as a hammer would. The use of the mallet is well illustrated by the making of a mortise and tenon joint, the chisel and mallet being used to cut the opening known as the mortise into which the tenon fits.

The Rip-saw:



The rip-saw is used for sawing parallel to the fibres or with the grain of the wood. The cutting faces of the teeth are almost at right angles to a line touching their points. They are nearly of the form of right-angled triangles. The blade of the saw tapers from the handle to the end and is also thinner toward the back; but this difference in the thickness is not great enough to allow the saw to work freely and easily. In order to secure this, the teeth have to be bent alternately to right and left. This bending, or "set", as it is called, makes the kerf, or saw gait, wider, but relieves the saw and allows it to work freely.



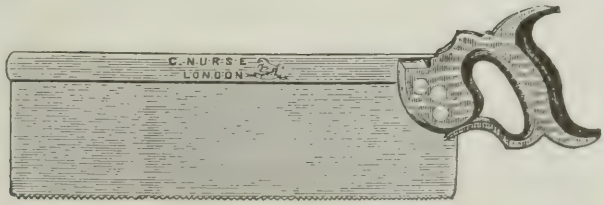
Cross Cut Saw

Rip Saw

The Crosscut-saw:

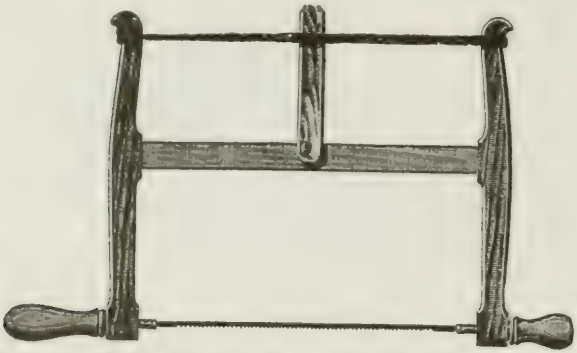
The crosscut-saw is used for cutting across the fibres or grain. It is similar in shape and construction to the rip-saw, but, as its work is of a different nature, the shape of the teeth is modified.

The Tenon, or Back-saw:



The tenon-saw has smaller teeth than the back-saw and also a thinner blade. The necessary rigidity is given by a brass or iron back which has a slight spring from handle to edge, and this gives additional stiffness to the blade.

The Turning-saw, or Bow-saw:

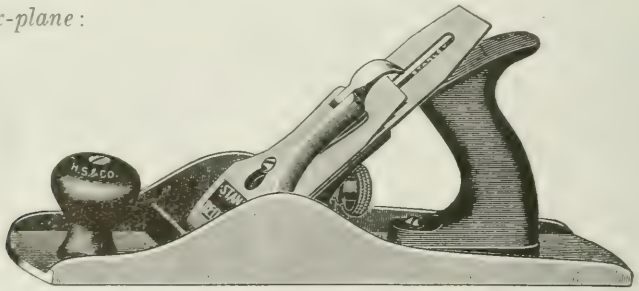


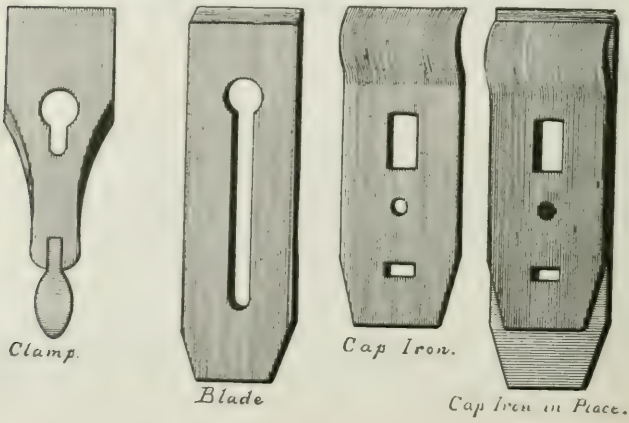
The bow-saw is fixed in a frame, the tightening of which gives to the blade the necessary rigidity otherwise unattainable, owing to the blade having to be narrow and thin in order that it may pass freely round a curve. Care should be taken to keep the cut at right angles to the surface. Any forcing or straining in use will twist and probably break the blade. A modification of this saw is the common form of buck-saw, much used for sawing rough lumber.

The Compass-saw:

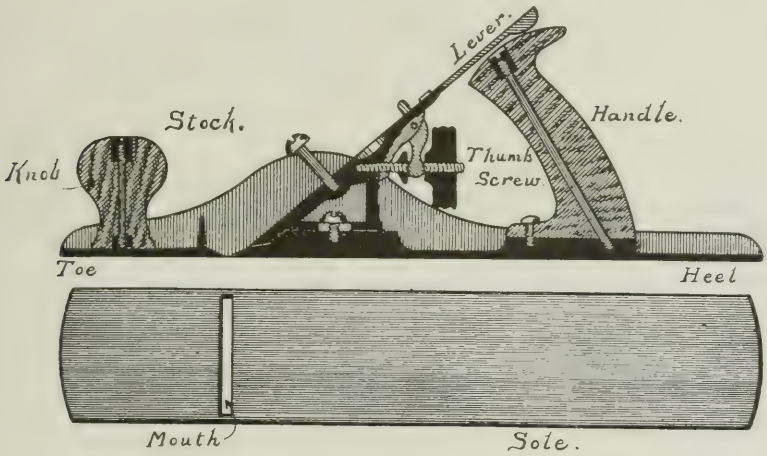
The compass-saw blade is narrow and tapers almost to a point. The blade is thick and widely set, to allow of free turning room in the sawing of curves, for which it is designed. Detachable handles may be obtained to hold blades of different sizes fixed by two set-screws. They are then called pad-saws, and, in the smaller sizes, keyhole saws, which name indicates their chief use.

The Jack-plane:



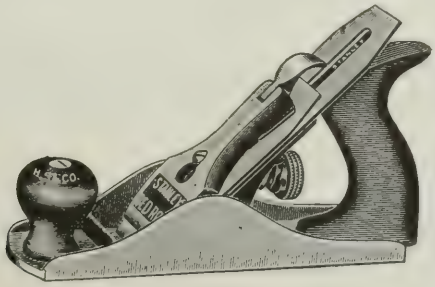


The jack-plane is used for the first dressing of timber, but with care it can be used for finer work also. A plane is really only, in principle, a chisel inserted through a cast-iron or wooden stock. The front end of the stock is the toe, and the back end is the heel. The bottom is the sole, and the opening or slit in it is called the mouth. The blade, which is the cutting iron of the plane, is fastened



in the stock by an iron clamp. Fastened to the top side of the blade is a cap-iron, which serves to strengthen it and also to break the shavings. In the cap-iron are three openings—a small slot at the upper end through which it is moved up and down; below this a small, round, threaded hole through which passes a short machine-screw which fastens the cap-iron to the blade; beneath this a larger slot, through which passes the longer machine-screw which is screwed into the frog, and by means of the clamp this screw holds the blade and cap-iron to the frog. Back of the frog and in front of the handle is the thumb-screw, which engages a lever that fits into the upper slot of the cap-iron and forces it up and down. This motion carries the edge of the blade in and out of the mouth and sets it for the depth of the cut.

The Smoothing-plane:

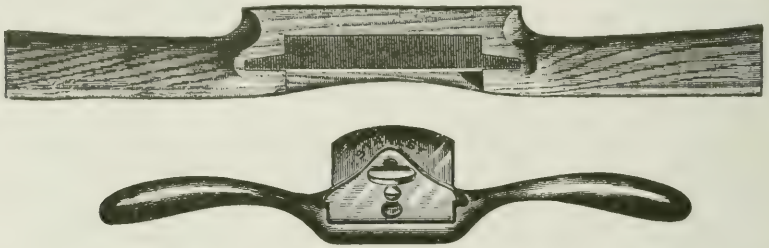


The smoothing-plane is shorter than the jack-plane, its work being to smooth the surface without regard to straightening it, as it is supposed that the straightening has been done previously.

The Draw-knife:

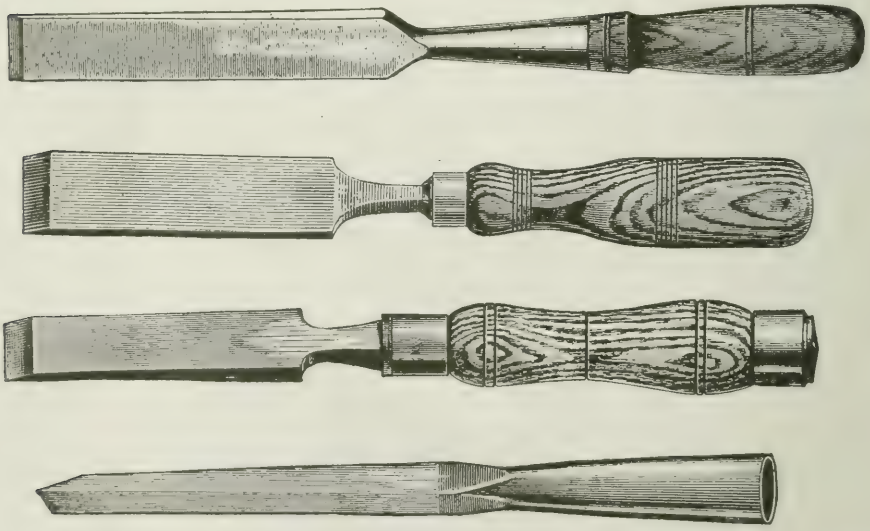
The draw-knife is used for rough modelling and instead of the axe for bringing the edge of a board to size. It has no guidance except that which can be given by the wrist through the handles. For this reason it will, if not carefully watched, follow the grain, and, as it is a powerful tool, waste of material may result. The edge is formed in two ways—sometimes on both sides, as in the knife, but more commonly on one side, as in the chisel, by grinding a bevel on one side at an angle of about 30 degrees and then setting on the oil-stone at an angle of 18 degrees to 25 degrees.

The Spoke-shave:



The spoke-shave is in reality a modification of the draw-knife, a desire to regulate the cut of which led to its adoption. The English pattern is of beech or box-wood, while the American pattern is made of iron. This is a finishing tool to the draw-knife and is employed in finishing many small curves for which the planes are unsuitable.

Chisels:



Chisels are cutting or edged tools and are described by the width of the blade. They range by eighths from 1/8 in. to 1 in., and by quarters from 1 in. to 2 in. The handles, which may be of any hard wood, are fastened to the blades either by a socket or by a tang. The socket is a hollow cone in one end of the blade, and

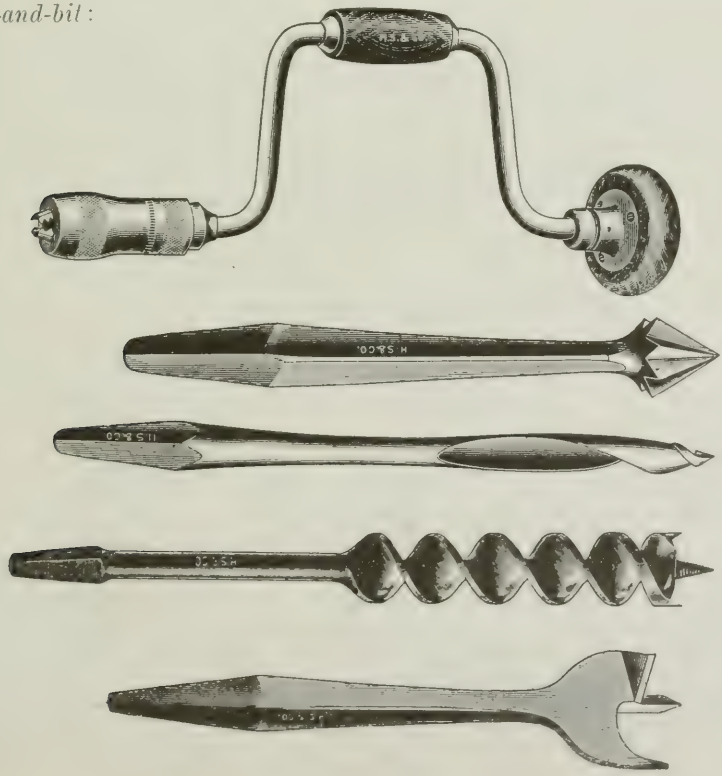
the handle is turned down to fit this socket. The tang is a sharp point with a shoulder and is driven into the handle up to the shoulder. The handle of a tanged chisel has a metal ferrule to prevent splitting. The tang is square in section, so as to prevent turning in the handle when the chisel is in use.

Chisels are divided into three general classes according to their uses. The paring chisel has a lighter blade, intended to be used in the light work of paring or taking thin shavings, and should never be driven by a mallet. The firmer chisel is heavier and is intended for all ordinary work. The mortise or framing chisel is the heaviest and is used for cutting mortises in heavy timbers. The handle is in a socket and has a heavy iron ferrule, or better still, a pad of leather at the upper end, to prevent its being splintered by the blows of the mallet.

The Brad-awl:

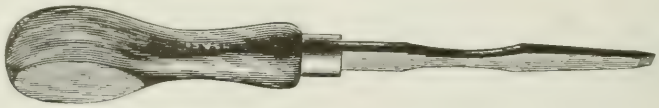
The brad-awl is the simplest boring tool. Unlike gimlets and bits, it does not take out any wood, but merely presses it aside out of the way. It consists of a small piece of steel rod with one end fastened into a wooden handle and the other doubly bevelled to a sharp edge. It is used with the cutting edge across the grain of the wood.

Brace-and-bit:



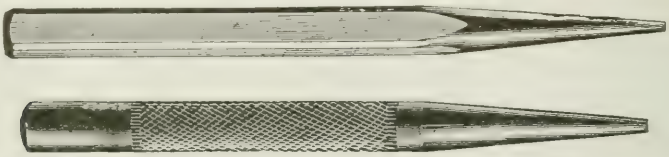
The brace is a device for holding the various forms of bits, and for giving them a continuous circular motion. It consists of a chuck which is made to grasp the square shank of the bit by revolving the sleeve which forces the jaws against the bit. The ratchet-brace is convenient for use in places where the sweep cannot make an entire revolution, for boring in hard wood, and for turning large screws. There is a large number of different kinds of bits used for various purposes. The most common are: auger-bit, centre-bit, gimlet-bit, countersink, and screwdriver-bit.

Screw-driver:



The screw-driver consists of a steel blade fixed into a handle by means of a tapered tang like that of the chisel. The edge should be as thick as the slot of a screw will allow, in order to have as much strength as possible. The shape of the handle varies—oval, flat, or round. A round-handled screw-driver is not so satisfactory as one with oval or flat handles, as it does not afford so good a grip. The tool is made in all sizes, from that suited to watch screws, to ½ in., and from 3 in. to 2 ft. in length.

Nail Punch, or Nail Set:



The nail punch is simply a piece of tapering steel used with a hammer for sinking the heads of nails below the surface of the wood. The best form of nail set is that which has a cupped or hollow point, as this is not so apt to slip from the head of the nail and so bruise the wood.

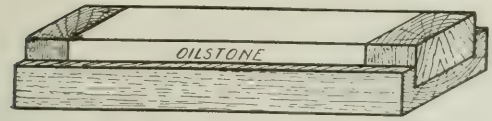
Cutting Pliers:

These are useful for cutting wires which may be put to various uses. They are also occasionally required for shortening nails for various purposes.

Wrenches:

Wrenches are of various kinds and patterns and are used for many purposes, but that known as the "monkey", or Coe's wrench, is the most convenient for general work and has not been supplanted by any of more recent invention.

The Oil-stone:



Oil-stones are of two kinds—natural and artificial. The most common natural stones are the Washita and the Arkansas, which are fine, hard, and expensive. These stones give a very fine edge on tools, but require a great deal of time and work to produce it.

Artificial stones of emery, corundum, and other abrasives are coming rapidly into use and will probably supplant all others in many occupations, as they cut faster than any natural stone, may be made of any degree of fineness, and are of absolutely even texture.

To prevent oil-stones being broken, they should be mounted in a wooden box. The figure shows a method of making a box, with two pieces of hard wood set upright at the ends and the tops flush with the top of the oil-stone. With this arrangement it is possible to use the stone clear to the ends, thus wearing it down evenly.

Mineral oils are not recommended, but some light animal oil that will not gum should be used sparingly, and the surplus wiped off when the sharpening is finished. After a stone has been used for some time, it becomes glazed and will not "bite". Kerosene or a mixture of equal parts of glycerine and alcohol may then be used. Soaking in dilute sulphuric acid or lye will also clean out a stone and make it work after all other efforts have proved useless.

The Grindstone:

The grindstone should, as a rule, be purchased mounted, as it is not an easy matter to swing a grindstone so that it shall run true to centre and perpendicularly. If the frame in which the stone is mounted be furnished with a treadle, grinding can be done by one person. The stones themselves are procured more or less from all the sandstone districts. The best are obtained from Lake Huron, and they are so good that they are largely exported. They are of various sizes, forms, and textures. A suitable size is 20 in. or 24 in. in diameter, and from 3 in. to 3½ in. thick. For wood-working tools, one of rather fine, soft grit is the best. A grindstone, when not in use, should not stand in water. During grinding the tool should be gradually moved across the face of the stone, in order to prevent unequal wear upon the stone.

Glue-pot and glue:

The glue-pot consists of an outer vessel to contain water and an inner vessel to contain the glue. Glue is the gelatin extracted from the parings of hides, hoofs, and the refuse of the more solid animal tissues. On looking through a cake of glue it should be clear and free from any cloudiness, and it should break under the hammer with a clear vitreous, or glassy, fracture. It is best prepared as follows: Break up the glue into small pieces, cover with water, and let it soak for twenty-four hours, pouring off any water that has not been absorbed. Place it over the fire and melt. When melted it is ready for use. Cold liquid glue may be obtained, which, though not so strong as the hot glue, will be found fairly satisfactory.

SQUARING UP STOCK

Squaring up stock is the basic wood-working operation. The term simply means reducing a piece of sawn or rough lumber to one having smooth, flat sides at right angles to one another and of definite length, breadth, and thickness. The success of any wood-working project depends very largely upon the accurate performance of this operation. The steps in order are as follows:

1. Choose the best face and plane level and true with the jack-plane. Examine by the eye, and test, by the try-square and the rule, whether this surface is true in length and width. If true, place a distinguishing mark upon it. This face, called the "working face", or simply, "face", becomes the basis from which all other sides are squared.

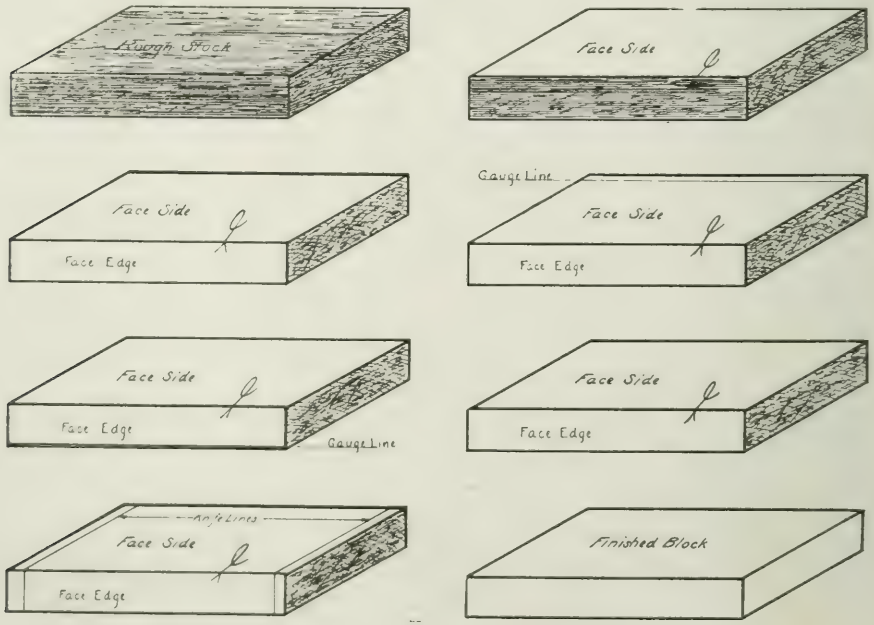
2. Plane one of the adjoining edges and make square with or at right angles to the face. This edge, known as the "working edge", or "face-edge", must be thoroughly tested throughout its entire length with the try-square and must be at right angles to the working face at every point. Place a distinguishing mark on this face.

3. Set the marking gauge at the required width, and, with gauge block or stock pressed closely against the face edge, gauge a fine line on the working face. Press very lightly at first and do not let the spur of the gauge follow the grain or press too deeply into the wood.

4. Plane down the second edge to the gauge line just drawn, squaring the edge with the working face and testing thoroughly with the try-square. The stock is now of the required width.

5. Set the gauge to the required thickness and gauge a light line on both edges from the working face.

6. Plane this edge parallel to the working face down to the two gauge lines just drawn. If this is done carefully the surface is bound to be true. The stock is now of the required width.



7. Carefully square a line around the four planed sides with a knife and a try-square as near to one end as possible.

8. From the line just drawn, measure the required length and square a line around the four sides as before. If the wood has been properly squared these lines will meet.

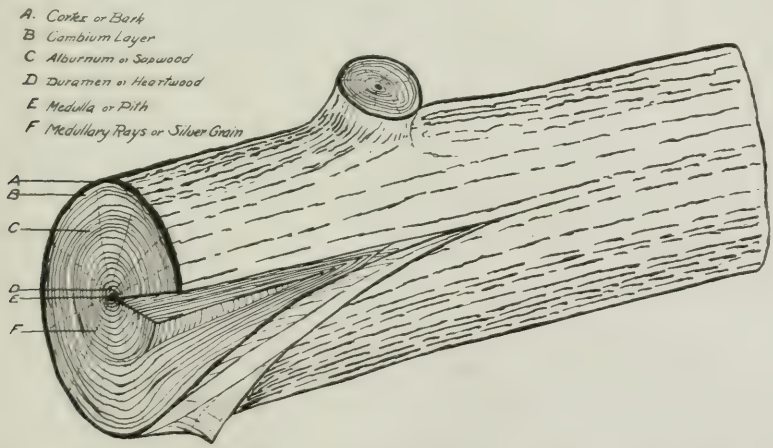
9. If necessary, saw close to the lines with the tenon-saw and finish with the smoothing-plane. Plane from both sides, so as not to break off the edges. Sometimes the block-plane is used for this, but the smoothing-plane is more satisfactory.

The operations described in numbers 7, 8, and 9 are often left until the work has been "laid out".

NOTES ON TIMBER

A much greater variety of trees is found in Ontario than in any other Province, and, as a natural consequence, the number of wood-employing industries is much larger than elsewhere in Canada. In the south-west of the Province, coniferous trees are almost wholly wanting, the forests being made up of hard woods, of which oak, hickory, basswood, maple, elm, ash, and beech are the most valuable. The forests of north and north-west Ontario resemble those of Quebec—pine, spruce, birch, and poplar being economically of most importance. Pine has long been the chief wood exported from Ontario, but it is, like our hard woods, gradually becoming scarce.

Few other countries produce so great a variety of trees as Canada. Of the one hundred and twenty-one indigenous species, a few are of small economic value, while others are so restricted in their distribution that commercially they cannot be taken into account. The following notes relate to a few of the most common trees grown in the Dominion, with their botanical, English, and French names, the characteristics of the timber, their products and uses, together with some hints as to the identification of the growing tree, leaves, fruit, etc.



NAME: *Tilia Americana;* Basswood: *Bois Blanc*: Lime tree: American Linden.

DISTRIBUTION: New Brunswick (sparingly), Quebec, Ontario (greatest size and most abundant), Eastern Manitoba.

CHARACTERISTICS: Light, soft, not strong, very close-grained, compact, easily worked; medullary rays numerous, rather obscure; colour light brown or often slightly tinged with red, sapwood hardly distinguishable.

PRODUCTS: Inner bark macerated, sometimes made into coarse cordage and matting.

USES: Woodenware, cheap furniture, panels and bodies of carriages, turnery, carving, paper, pulp (not suitable for white paper). All Grinling Gibbons' carving was done in basswood.

TREE: Always an indication of rich soil; 70 to 130 feet high, trunk erect; bark light and furrowed; surface scaly; buds deep red, spring buds a vivid green; leaves nearly heart-shaped, five to six inches long and three to four inches broad.

NAME: *Acer Saccharinum;* Hard Maple; Sugar Maple; Sugar Tree; Rock Maple; *Érable à Sucre.*

DISTRIBUTION: Prince Edward Island, Nova Scotia, New Brunswick, Quebec, and Ontario.

CHARACTERISTICS: Heavy, hard, strong, close-grained, compact, takes a good polish; medullary rays numerous, thin; colour light brown tinged with red, sapwood lighter; curled and bird's-eye maple accidental forms highly prized by cabinet-makers.

PRODUCTS: Maple sugar, ashes rich in alkali yield large quantities of potash.

USES: Furniture, shoe-lasts, pegs, turnery, flooring.

TREE: On young trees and large limbs bark light gray, smooth, and slightly furrowed; on old trees dark, with deep longitudinal furrows, shaggy; 50 to 120 feet high; blooms in April and May; fruit appears in September; frequently rises to 70 feet without a branch; dense foliage.

Name: *Acer Dasycarpum,* Silver Maple; Soft Maple; White Maple; *Erable Blanche.*

DISTRIBUTION: New Brunswick, Quebec, Ontario.

CHARACTERISTICS: Light, hard, strong, brittle, close-grained, compact, easily worked; medullary rays numerous and thin.

PRODUCTS: Maple sugar, occasionally.

USES: Cheap furniture, flooring.

TREE: Along streams and intervales in rich soil; 90 to 100 feet high; leaves five to seven inches long; bark on young trees light gray and smooth; on old trees reddish brown more or less furrowed, the surface separating into large, loose scales.

NAME: *Fraxinus Americana,* White Ash, *Frêne Blanc.*

DISTRIBUTION: Prince Edward Island, Nova Scotia, New Brunswick, Quebec, Ontario.

CHARACTERISTICS: Heavy, hard, strong, brittle, close-grained, compact; layers of annual growth clearly marked by several rows of large, open ducts occupying in slowly-grown specimens nearly the entire width of the annual rings; medullary rays numerous, obscure; colour brown, sapwood lighter, often nearly white.

USES: Agricultural implements, carriages, oars, cabinet work, handles.

TREE: Low, rich, rather moist soil; sometimes 100 feet, but usually 70 or 80 feet, straight trunk three feet or more in diameter at the base; bark gray, deeply furrowed into narrow flattened ridges, surface scaly; blooms April to June; name refers to the pale, sometimes silvery undersurface of the leaf.

NAME: *Betula Papyrifera,* White Birch, Paper Birch, Canoe Birch, *Bouleau à Papier ou à Canot.*

DISTRIBUTION: Prince Edward Island, Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, North-west Territories, British Columbia.

CHARACTERISTICS: Light, strong, hard, tough, very close-grained, compact; medullary rays numerous, obscure; colour brown tinged with red, sapwood nearly white.

USES: Spools, shoe-lasts and pegs, turnery, fuel, wood-pulp, bark for canoes, tents, etc.

TREE: Rich woodlands and banks of streams; shape pyramidal; branches pendulous; 40 to 70 feet, or higher; blooms in April and May; bark chalk white, smooth and disagreeable to the touch, readily peeling, separating into thin, papery sheets which are faint red in colour and marked with short, dark lines; sap flows freely in spring, and, by boiling, can be made into syrup.

NAME: *Populus balsamifera,* Balsam Poplar, Balsam, Tacamahac, Balm of Gilead, *Baumier.*

DISTRIBUTION: In every part of Canada.

CHARACTER: Very light, soft, not strong, close-grained, compact; medullary rays numerous, very obscure; colour brown, the thick sapwood nearly white.

PRODUCTS: Buds covered with a resinous exudation, occasionally used as substitute for turpentine and other balms.

USES: Pails, tobacco boxes, paper-pulp.

TREE: Very common on all islands and shores of the Northern Rivers; erect, narrow, open head; 60 to 80 feet; blooms April, fruits May and June. Bark gray tinged with red, ridged, branches smooth, with wart-like excrescences.

NAME: *Juglans Cinerea,* Butternut, White Walnut, *Noyer Tendre.*

DISTRIBUTION: New Brunswick, Quebec, Ontario.

CHARACTERISTICS: Light, soft, not strong, rather coarse-grained, compact, easily worked, satiny, takes a beautiful polish; medullary rays distant, thin, obscure; colour bright light brown, turning brown with exposure, sapwood lighter.

PRODUCTS: Inner bark used medicinally, furnishes a yellow dye.

USES: Interior finish, cabinet-work, etc.

TREE: Unsymmetrical, branches horizontal, 30-50-100 feet; blooms May, fruits October and November; bark light brown deeply ridged; branchlets light gray, rough; twigs sticky; sheds its leaves early in the autumn; young trunks and branches smooth, and light gray branchlets at first orange brown or bright green.

NAME: *Juglans Nigra,* Black Walnut, *Noyer Noir.*

DISTRIBUTION: Ontario.

CHARACTERISTICS: Heavy, hard, strong, rather coarse-grained, liable to check if not carefully seasoned, easily worked, takes a beautiful polish, durable in contact with the soil; medullary rays numerous, thin, not conspicuous; colour rich dark brown, the thin sapwood much lighter.

USES: Cabinet-making, interior finish, gun stocks.

TREE: Rounded branches very thick, 30-60-150 feet; blooms April and May, fruits October; bark blackish, rough, broadly ridged, 100 years to grow to maturity, grows slowly; trunk four to six feet in diameter; branchlets hairy, dull orange brown, later becoming darker brown. Leaves appear late in spring and fall early in autumn, so that the tree often stands naked when its neighbours are apparently in full leaf.

NAME: *Quercus* Alba, White Oak, *Chêne Blanc.*

DISTRIBUTION: Quebec.

CHARACTERISTICS: Strong and heavy, hard, tough, close-grained, liable to check unless carefully seasoned; durable in contact with the soil; layers of annual growth strongly marked by several rows of large open ducts; medullary rays broad, prominent; colour brown and sapwood lighter brown.

USES: Ship-building construction of all sorts, cooperage, carriages, agricultural implements, baskets, railway ties, fencing, interior finish, cabinet-making, fuel, etc.

TREE: Head broad, branches spreading; blooms May and June, fruits September and October. Bark, light gray or nearly white, less rough than that of most oaks, often scaly in old trees and breaking off in thin sheets; 80 to 100 feet; trunk three to four feet in diameter.

NAME: *Quercus Rubra,* Red Oak, Black Oak, *Chêne Rouge.*

DISTRIBUTION: Ontario.

CHARACTERISTICS: Heavy, hard, strong, coarse-grained, inclined to check in drying; layers of annual growth marked by several rows of large open ducts; medullary rays few and conspicuous; colour light brown or red, sapwood somewhat darker.

USES: Clapboards, cooperage, sometimes for interior finish, chairs.

TREE: 70-80-140 feet; stout branches, growing at right angles to stem; narrow round-topped head; bark gray-brown tinged with red; large acorns.

NAME: *Ulmus Fulva,* Red Elm, Slippery Elm, Moose Elm, *Orme Rouge.*

DISTRIBUTION: Quebec, Ontario.

CHARACTERISTICS: Heavy, hard, strong, very close-grained, compact; durable in contact with the ground; splitting readily when green; layers of annual growth clearly marked by several rows of large open ducts; medullary rays numerous and thin; colour dark brown or red, the thin sapwood lighter.

PRODUCTS: Inner bark extensively used in medicinal preparations.

USES: Wheel-stock, fence posts, rails, ties, sills, etc.

TREE: Borders of streams and hillsides in rich soil; head broad and flat, spreading; 60 to 70 feet high; blooms March and April, fruits May; bark reddish brown, rough; branches bright green when young, turning to light gray; trunk sometimes two feet in diameter; leaves rough whichever way they are rubbed; buds hairy.

NAME: *Ulmus Americana,* White Elm, American Elm, Water Elm, *Orme Blanc.*

DISTRIBUTION: Prince Edward Island, Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba.

CHARACTERISTICS: Heavy, hard, strong, tough, rather close-grained, compact, difficult to split; annual layers clearly marked by several rows of large open ducts; medullary rays numerous, thin; colour light brown, sapwood somewhat lighter.

USES: Wheel-stock, saddle-trees, flooring, cooperage, largely exported to Great Britain, used in ship-building.

TREE: 60 to 120 feet high, trunk sturdy, usually dividing at one third the height of the tree into two to five branches; bark dark gray; rough branchlets light green, downy, later becoming reddish-brown, smooth, and, finally, ashy-gray.

NAME: *Castanea Americana,* Chestnut, *Chataignier.*

DISTRIBUTION: Ontario.

CHARACTERISTICS: Light, soft, not strong, coarse-grained, liable to check or warp in drying, easily split; very durable in contact with the soil; layers of annual growth marked by many large, open ducts; medullary rays numerous, obscure; colour brown, sapwood lighter.

PRODUCTS: Used medicinally, edible nuts.

USES: Cabinet-making, railway ties, posts, fencing, etc.

TREE: Round-topped, branches spreading; blooms June and July, fruits in September and October; bark, granite-gray, ridged but smooth in young trees; occasionally 100 feet high; branchlets at first light yellow green, finally olive green, and ultimately dark brown.

NAME: *Fagus Ferruginea,* American Beech, *Hêtre.*

DISTRIBUTION: Prince Edward Island, Nova Scotia, New Brunswick, Quebec, Ontario.

CHARACTERISTICS: Very hard, strong, tough, very close-grained; not durable in contact with the soil; inclined to check in drying, difficult to season, takes a beautiful polish; medullary rays broad, very conspicuous; colour varying greatly with soil and situation, dark red or often lighter, sapwood nearly white.

USES: Chairs, shoe lasts, plane-stocks, handles, etc., and for fuel.

TREE: 70 to 80 feet high; in forests, tall, slender, with narrow head; in open situation, short-stemmed, forming a round-topped head of slender, slightly drooping branches; bark compact, smooth, ashy-gray; branchlets at first pale green, then olive green, finally changing through brown to ashy-gray.

NAME: *Pinus Strobus,* White Pine, Weymouth Pine, *Pin Blanc.*

DISTRIBUTION: Prince Edward Island, Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba.

CHARACTERISTICS: Light, soft, not strong, very close straight-grained, compact, easily worked, takes a beautiful polish; bands of summer cells thin not conspicuous; resin passages small not numerous nor conspicuous; medullary rays numerous, thin; colour light brown, often slightly tinged with red, sapwood nearly white.

USES: Lumber, shingles, laths, building material, cabinet-making, interior finish, manufacture of matches, wooden-ware, and for many domestic purposes.

TREE: 80 to 175 feet; blooms June, fruits September; bark light greenish-gray, smooth on young trees and branches, becoming rough and brownish with age; leaves needle-shaped, three-sided, light green, cones reddish brown, four to six inches long.

NAME: *Pinus Resinosa,* Red Pine, Norway Pine, *Pin Rouge.*

DISTRIBUTION: Prince Edward Island, Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba.

CHARACTERISTICS: Light, not strong, hard, coarse-grained, compact; bands of broad summer cells dark coloured, very resinous, resin passages are small, not conspicuous; medullary rays numerous, thin; colour light red, sapwood yellow or often white.

USES: Lumber, all purposes of construction, flooring, piles, etc.

TREE: 50-90-150 feet; blooms May and June; bark reddish brown, almost smooth, becoming scaly when old; branches red; smooth leaves needle-shaped, rounded on the upper side, lower side hollowed; cones two to three inches long generally at the apex of the branches in crowded clusters.

NAME: *Pseudotsuga Douglasii,* Douglas Fir, *Pin d'Oregon.*

DISTRIBUTION: North-West Territories, Rocky Mountains, British Columbia.

CHARACTERISTICS: Hard, strong, varying greatly with age and conditions of growth in density, quality, amount of sap; difficult to work, durable; bands of small summer cells broad, occupying fully half the width of the annual growth, dark coloured, conspicuous, soon becoming flinty and difficult to cut; medullary rays numerous, obscure; colour varying from light red to yellow, the sapwood nearly white.

PRODUCTS: Bark found valuable in tanning leather.

USES: All kinds of construction, railway ties, piles, fuel, etc.

TREE: Noble tree, 250 feet in height; bark, when tree is old, is rugged and six to nine inches thick; tree also known as the Oregon Pine.

NAME: *Thuya Occidentalis, Arbor Vitae,* White Cedar, *Cédre Blanc.*

DISTRIBUTION: Prince Edward Island, Nova Scotia, New Brunswick, Ontario, Quebec, Manitoba.

CHARACTERISTICS: Very light, soft, not strong, brittle, rather coarse-grained, compact, very durable in contact with the soil; the bands of dark summer cells very thin, dark coloured; medullary rays numerous and distinct; colour light brown, turning darker with exposure, sapwood nearly white.

PRODUCTS: Distilled oil and tincture of the leaves used medicinally.

USES: Posts, fencing, railway ties, shingles.

TREE: Cold, wet swamps, and along the banks of streams; a narrow conical evergreen tree, with flat frond-like foliage; height about 60 feet.

NAME: *Fraxinus Sambucifolia,* Black Ash, Hoop Ash, Water Ash, *Frêne Noir.*

DISTRIBUTION: Prince Edward Island, New Brunswick, Nova Scotia, Quebec, Ontario.

CHARACTERISTICS: Heavy, soft, not strong, rather coarse-grained, compact, durable; separating easily into layers; annual rings strongly marked by several rows of large, open ducts; medullary rays numerous, thin; colour dark brown, sapwood light brown, often nearly white.

USES: Interior finish, barrel hoops, cabinet-making, basket manufacture.

TREE: Swamps and low river banks, the most northern representative of the genus in America, head narrow, slender; branches upright; blooms April and May, fruits July; bark tinged with gray, rough and broken into irregular plates, becoming smooth in the branches.

NAME: *Fraxinus Pubescens,* Red Ash, *Frêne Rouge.*

DISTRIBUTION: Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba.

CHARACTERISTICS: Heavy, hard, strong, brittle, coarse-grained, compact; medullary rays numerous, thin; colour rich brown, sapwood light brown streaked with yellow.

USES: Somewhat used as a substitute for more valuable white ash.

TREE: Borders of trees and swamps in low ground; averaging 40 to 50 feet high, with stout, upright branches and irregular head; bark brown and ashy-gray; leaves turn yellow and brownish-yellow in the autumn before falling.

NAME: *Tsuga Canadensis,* Hemlock, *Pruche.*

DISTRIBUTION: Prince Edward Island, New Brunswick, Quebec, Ontario.

CHARACTERISTICS: Light, soft, not strong, brittle; coarse, crooked grain, difficult to work, liable to wind shakes and splinters, not durable; medullary rays numerous, thin; colour light brown tinged with red or often nearly white, sapwood somewhat darker.

PRODUCTS: Bark rich in tannin used for tanning-bath.

USES: Coarse lumber, and used in construction for outside finish, railway ties.

TREE: 70 to 100 feet; bark reddish brown or gray, deeply divided into ridges covered with closely-pressed scales; branchlets at first pale brown, later becoming darker, finally, dark gray-brown with purple tinge.

NAME: *Liquidambar Styraciflua,* Sweet Gum, Red Gum, sometimes Satin Walnut.

DISTRIBUTION: Not a native of Canada; grows in United States south of Connecticut only.

CHARACTERISTICS: Rather heavy, rather soft, quite stiff, and strong, tough, commonly cross-grained, of fine texture; the broad sapwood whitish, the heartwood reddish-brown; shrinks and warps considerably, stands well when fully seasoned; takes good polish.

USES: Used in Ontario as a substitute for bass wood and tulip for inside work in furniture manufacture and body work in vehicles; furniture veneer; wagon hubs, etc.

TREE: A large-sized tree; very abundant, often the principal tree in the swampy parts of the Lower Mississippi Valley; occurs from New York to Texas and Indiana to Florida.

NAME: *Liriodendron Tulipifera,* Whitewood, Yellow Poplar, *Tulipier.*

DISTRIBUTION: Southernmost part of Ontario, New England to Florida, westward intermittently to Michigan and Mississippi.

CHARACTERISTICS: Heartwood light yellow or greenish-brown, thin sapwood nearly white; close-grained, compact structure free from knots; light, soft, moderately strong, brittle, easily worked, durable, hard to split, shrinks little, resembles white pine, stands well.

USES: Lumber, interior finish, shingles, boat-building, pumps, wooden-ware shelves, the bottoms of drawers.

TREE: 90 to 150 feet in height, six to ten feet in diameter; tulip-shaped flowers in spring; greenish cones dry and remain after leaves have fallen.

NAME: *Carya Alba,* Shell-back Hickory, Shagbark Hickory, White Walnut. *Noyer Tendre.*

DISTRIBUTION: Quebec.

CHARACTERISTICS: Heavy, hard, strong, tough, close-grained, compact, flexible; layers of annual rings clearly marked, with one to three rows of large, open ducts; medullary rays numerous, thin; colour brown, the thin and more valuable sapwood nearly white.

PRODUCTS: Sweet and edible nuts afford an important article of commerce.

USES: Agricultural implements, carriages, axe-handles, etc.

TREE: Rich hillsides and sandy ridges; 100 feet high, with a straight columnar trunk; bark dark gray, separates into strips often three or more feet

long, and three to eight inches wide, which cling to the trunk, usually by the middle, giving it a rough, shaggy appearance, on young stems and branches smooth and light green; blooms in May, fruits September and October.

NAME: *Taxodium Distichum,* Cypress, Bald Cypress.

DISTRIBUTION: Not a native of Canada; grows in South-Atlantic and Gulf States; forms forests in swamps.

CHARACTERISTICS: Heartwood brownish, sapwood nearly white; close, straight grain, frequently pitted by disease; light, soft, not strong, durable; green wood often very heavy.

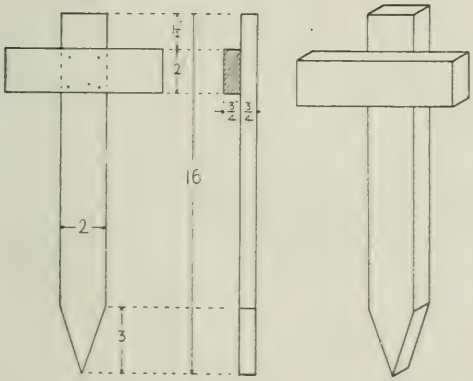
USES: Carpentry, construction, cooperage, railway ties.

TREE: 70 to 150 feet in height; four to ten feet in diameter.

SUGGESTED PROJECTS

The manual training which is offered and suggested in the rural schools and in continuation schools and high schools in rural districts should be principally of an agricultural nature. It creates a desire to use tools in making articles for use in the farm-home and on the farm, and leads to the desire to keep in repair and improve farm buildings and equipment. Work of this character develops a more intimate relationship between the home and the school. In some cases it has led to the equipment and use of a shop on the farm. In the suggestion of these projects no attempt has been made to outline a "course". The projects suggested are all objects which have been successfully made in rural schools, and they are offered as suggestions for both school and home work.

Plant Label:



Any soft wood may be used:

Stock required 7/8 in. x 2¼ in. x 24 in.

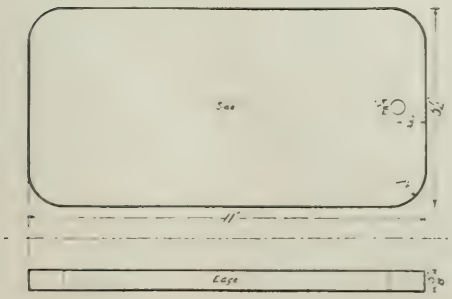
Square up to ¾ in. x 2 in.

Saw off cross-piece and square the ends.

Square ends of long piece.

Measure 3 in. from end of long piece and square line across. Mark the centre point of the end and draw lines from this point to the ends of the line just drawn. Saw to lines with rip-saw and finish with chisel and sand-paper. Start nails in cross-piece and drive in till points just come through. Place cross-piece in position and nail.

Bread Board:



One piece of basswood or pine.

Square up to 5/8 in. x 5½ in. x 11 in.

The rounded corners are made by measuring one inch from the end and one inch from the edge, and, with compasses set at 1 in. radius, striking an arc. The stock is then removed with a 1-in. or ¾-in. chisel. Locate the position of the hole and bore from both sides to prevent splitting.

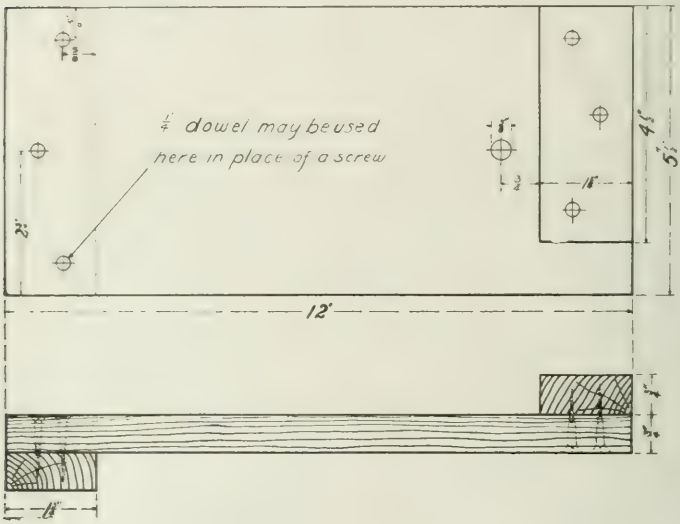
Bench hook:

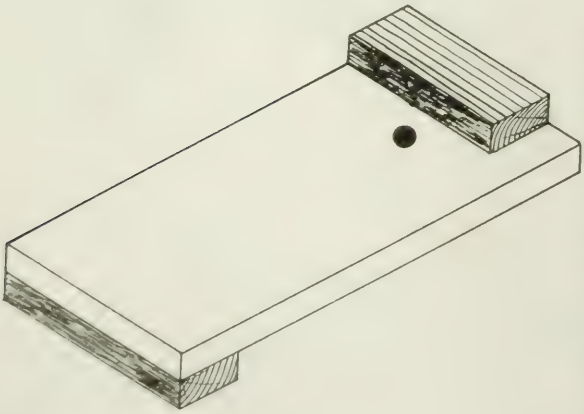
Stock required:

1 piece white pine 13/16 in. x 5⅝ in. x 12½ in.
1 piece white pine 13/16 in. x 1⅞ in. x 11 in.
6 flat-head wood screws 1¼ in. No. 8.

Square up stock to—

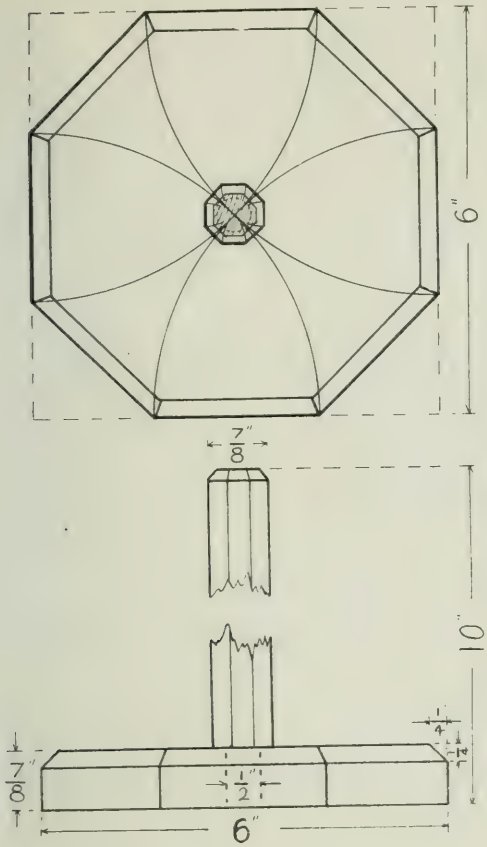
1 piece ¾ in. x 5½ in. x 12 in.
1 piece ¾ in. x 1¾ in. x 5½ in.
1 piece ¾ in. x 1¾ in. x 4½ in.





Bore the hole. Screw on blocks as shown in the drawing. Use a 5/32-in. twist bit and countersink the holes so that the heads of the screws are slightly below the surface of the wood. If white pine or other soft wood is used, the screws may be forced into the larger piece without boring; but if yellow pine or hardwood is used, a hole should be made with a smaller bit, for starting the screw.

Ring Toss:



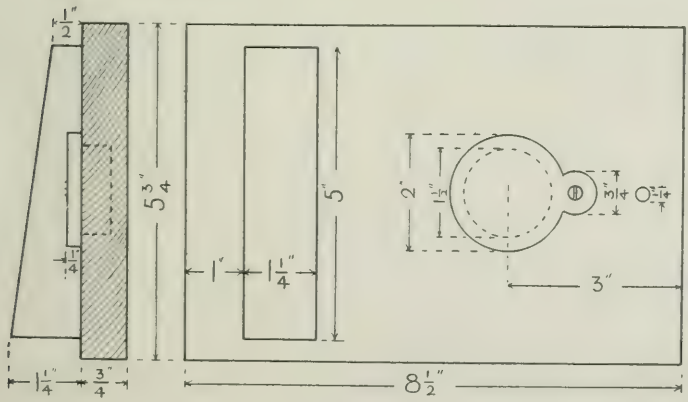
Pine, basswood, or cypress may be used.

Stock required:

1 piece 1 in. x 7 in. x 7 in.
1 piece 1 in. x 1 in. x 11 in.
1 piece 3/8 in. dowel 2 in. long.

Square up base. Set out octagon (see page 114). Saw with tenon-saw, measure 1/4 in. on the face all round, giving an inner octagon. Draw line 1/4 in. from the face all round the edge. Make chamfer with chisel. Bore 1/2-in. hole. Square up stick. Draw octagon on each end and connect with lines. Plane to octagonal form. Saw to length. Bore hole 1 in. deep. Glue, and insert dowel in both base and upright. Rings may be made of rattan or strips of 1/8-in. basswood soaked in water, and the joints may be bound with wire. They may be covered with strips of coloured cloth. The base and upright may be made round or hexagonal instead of octagonal.

Knife-Polishing Board:



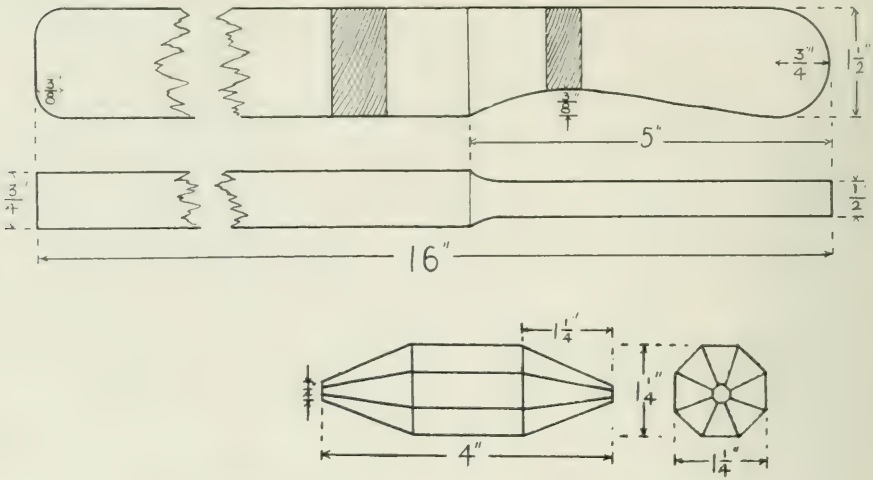
Stock required:

Pine stock 9 in. x 6 in.

Pine stock 1 1/4 in. x 5 1/2 in.

Square up base and block to sizes shown, being careful to get the correct taper on the block. The depth of the hole may be made to suit, but not so deep that the spur of the bit will come through. Cut the circular lid with bow-saw and finish with chisel. The block is screwed from the under side, and the heads countersunk. Bore the hole for hanging from both sides.

Bat and Tip-cat:



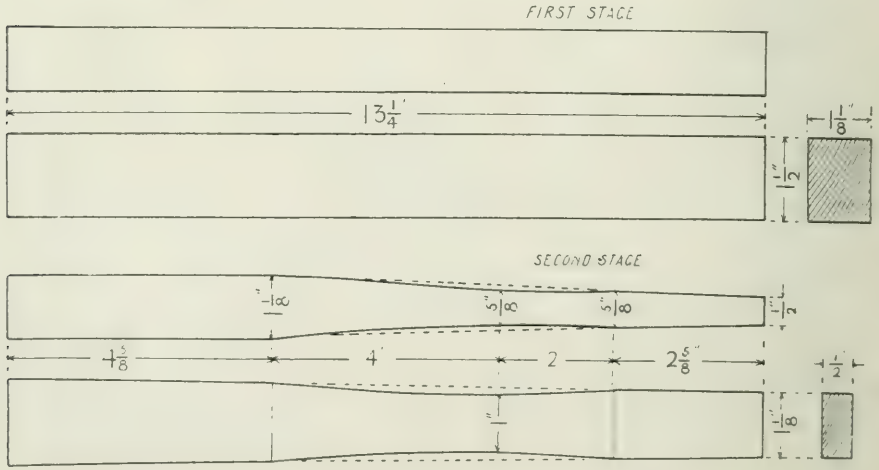
White pine, cypress, or any hard wood (lasts much longer if made of hard wood).

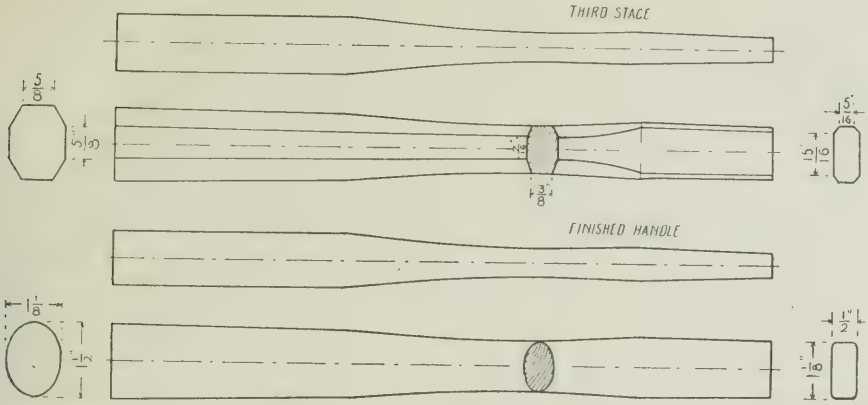
Cut pieces for bat 1 in. x 2 in. x 16½ in. Square up to finished size. Shape the handle with the spoke-shave.

Cut pieces for tip-cat 1¼ in. x 1¼ in. x 4½ in.

Square to finished size. Make octagonal in shape. Measure 1¼ in. from each end and square line all round. Plane ends to point from 1¼-in. line. leaving it ¼ in. broad. Sand-paper carefully and give one coat of linseed oil.

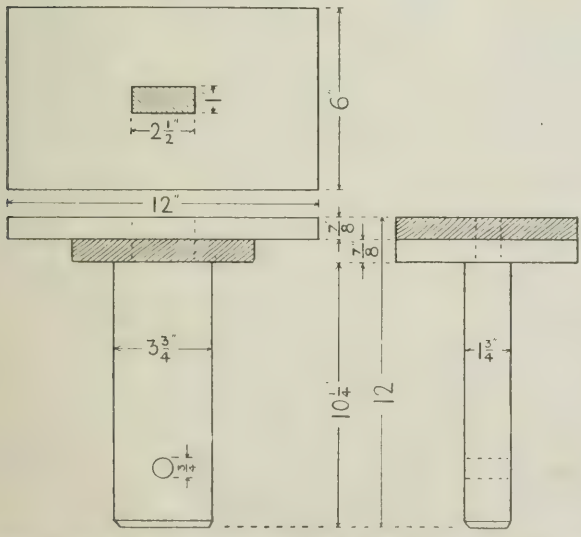
Hammer Handle:





For this model one piece of hickory is required 1¼ in. x 1⅝ in. x 13 ⅜ in. Square up stock. Draw slanting lines on wide surface, tapering them from 1½ in. at one end to 1⅛ in. at the other, and plane. On narrow surface beginning 4⅝ in. from large end draw slanting lines, tapering from 1⅛ to ½ in. at small end, and plane to slanting lines. Shave the small part of the handle to 1 in. in width and ⅝ in. in thickness. Bevel corners with spoke-shave or large knife, so that handle will be eight-sided. Remove each sharp edge, making elliptical from large end to within 4 in. of small end, which should be left nearly square with the corners slightly rounded. Smooth with fine sand-paper and rub with linseed oil. When the small end has been fitted to the eye of the hammer-head, it should be split with a chisel and a sharp hardwood wedge driven in, spreading the end so that the hammer-head will not fly off when being used.

Milking Stool:



Stock required:

1 piece 1 in. x 6½ in. x 21 in.

1 piece 2 in. x 4 in. x 14 in.

The finished dimensions are:

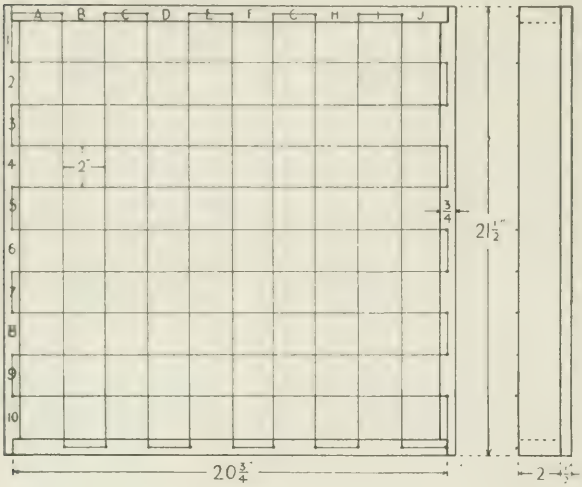
Seat ⅞ in. x 6 in. x 12 in.

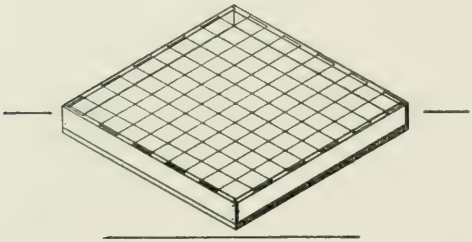
Seat brace ⅞ in. x 6 in. x 6 in.

Leg 1¾ in. x 3¾ in. x 12 in.

After squaring to size, place the seat brace in the middle of the bottom of the seat, grain running crosswise; nail from the top sides of the seat, and clinch the nails. Lay out the mortise on both sides. Bore two ¾-in. holes and trim to the lines with a ¾-in. chisel. Saw out the tenon and make it fit tightly into the mortise. Saw a slot through the middle of the tenon, and, when fitted into the mortise, drive in a small hard-wood wedge. Bore a ¾-in. hole in the leg or the seat of the stool so that the stool may be hung up when not in use.

Seed Germinator:





The seed germinator consists of a shallow tray 20 in. x 20 in. x 2 in., inside measurement.

Square up stock as follows:

Two pieces 21½ in. x ¾ in. x 2 in. for the ends,

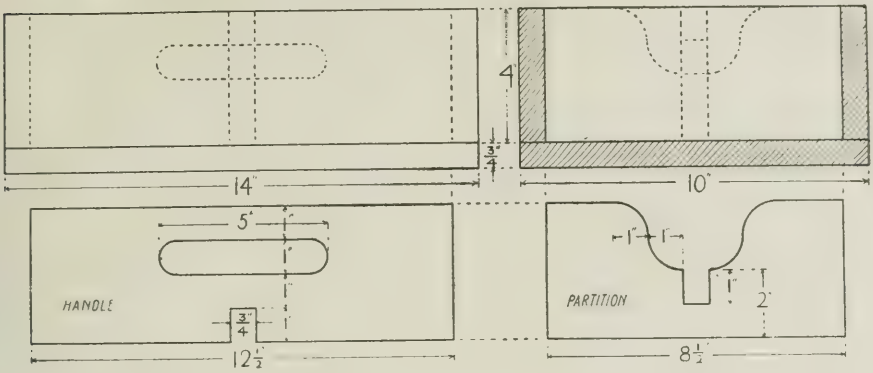
Two pieces 20¾ in. x ¾ in. x 2 in. for the sides,

Two pieces 21½ in. x ½ in. x 10¾ in. for the bottom.

Cut notches in the ends of the end pieces, so as to fit ends of side pieces, as shown in the drawing. Nail ends to sides, using 8-penny finishing nails. Put three nails into each corner—two through the end pieces into the side pieces, and one through the side piece into the end piece. Nail the bottom boards in place, using 6-penny finishing nails. Cover the crack between the two boards with a narrow strip (not shown in the drawing), to prevent the soil falling through. Drive 6-penny finishing nails 2 inches apart along each of the top edges. String wire or cord around the nails, thus dividing the tray into 100 squares.

Letter the top edge and figure the side edge. To use the tray, fill with soil or sand, then plant the kernels of corn or other seeds in the squares, dampen the soil freely, and keep in a warm place. The seeds may be identified by the number and letter of the square in which the kernels are planted.

Nail Box:

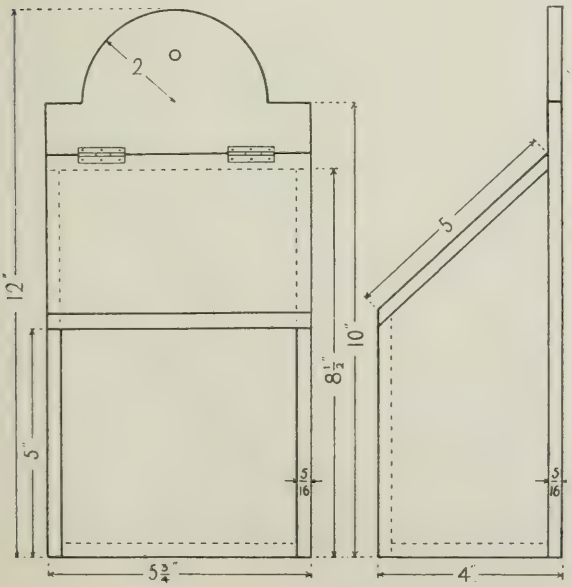


Square up stock as follows:

Two pieces 14 in. x 4 in. x ¾ in. for the sides,
Two pieces 8½ in x 4 in. x ¾ in. for the ends,
One piece 12½ in. x 4 in. x ¾ in. for the handle,
One piece 8½ in. x 4 in. x ¾ in. for the partition,
Two pieces 14 in. x 5 in. x ¾ in. for the bottom.

Set out hole for handle. Bore with brace and bit and cut out with chisel or knife. Cut out bottom slot. Set out partitions. Cut with bow-saw, tenon-saw, and chisel. Finish curves with knife. Nail sides to ends, using 6-penny nails. Put three nails in each. Plane edges even, if necessary. Test corners to see if square and nail on the bottom. Fit the handle to the partition. Place in the box and nail with three nails on each side and end.

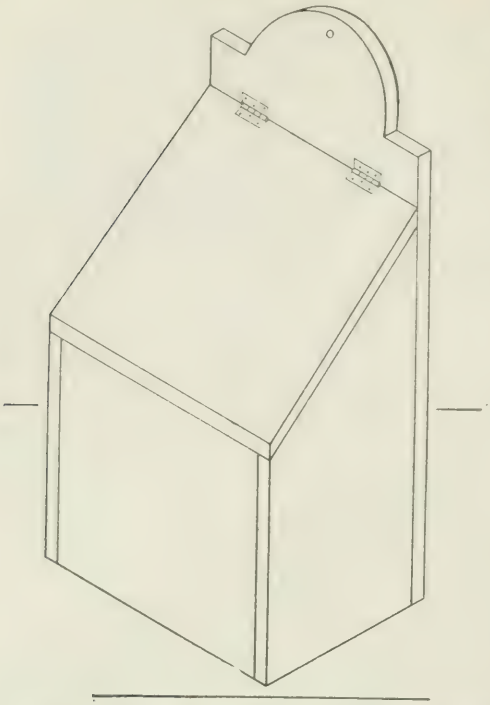
Salt Box:



One piece of white pine surfaced on four sides, ⅜ in. x 6 in. x 4 in. will cut the material. If white pine is not available, lumber from a box may be made to answer. The finished sizes of the pieces required are as follows:

One for back 5/16 in. x 5¾ in. x 12 in.
Two for sides 5/6 in. x 3 11/16 in. x 8½ in.
One for front 5/16 in. x 5¼ in. x 5⅛ in.
One for bottom 5/16 in. x 3⅜ in. x 5⅛ in.
One for cover 5/6 in. x 5 in. x 5¾ in.

Set out the sizes on the board, allowing ½ in. longer



and ⅛ in. wider for squaring. If planed lumber has been purchased, it may not be necessary to plane to the thickness. Finish the back to size, lay out and cut the semicircle, and bore the hole. Finish with sand-paper.

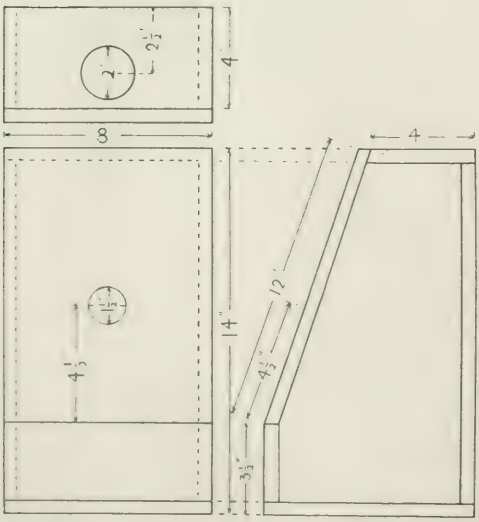
The sides are finished to the required dimensions, and then one edge of each is made 5 in. long and the other 8½ in.

The front, after being finished to size, is bevelled on one edge lengthwise ¼ in. down on one side, in order to allow the lid to fit snugly. The bottom is finished to the required dimensions—5/16 in. x 3⅜ in. x 5⅛ in.

Bevel one edge of the cover ¼ in. down on one side with the grain, then bevel the other edge ¼ in. down on the other side. (If the cover is made from ¼ in. to ½ in. wider, the box can be opened by lifting the cover from beneath with the finger, thus avoiding the use of a knob.)

Nail the sides to the back. Place the front between the sides, and nail. Fit and nail the bottom. Place the cover on, see that the bevels fit, and screw hinges on the cover and back. Screw in the knob if required. Sand-paper with the grain and stain any desired colour.

Egg Candler:



Square up pieces as follows and in the order given:

One piece for back ½ in. x 8 in. x 13 in.

Two pieces for sides ½ in. x 7 in. x 13 in.

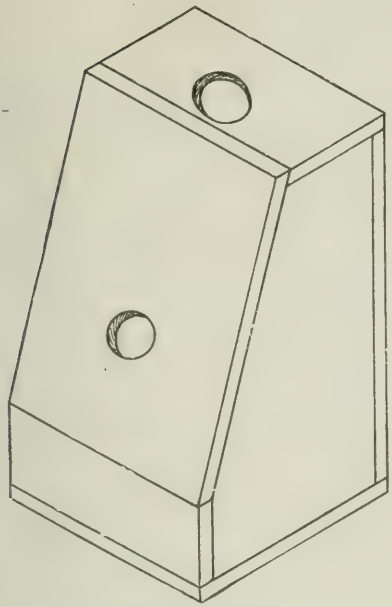
One piece for front ½ in. x 3 in. x 8 in.

One piece for bottom ½ in. x 8 in. x 8 in.

One piece for top ½ in. x 4 3/16 in. x 8 in.

One piece for door ½ in. x 8 in. x 12 3/16 in.

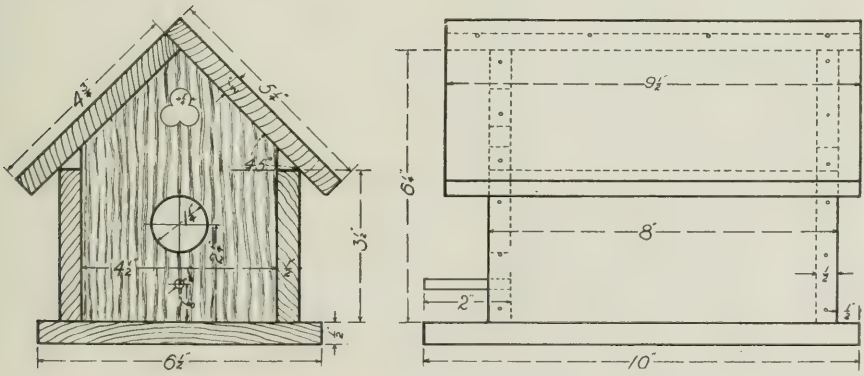
After shaping the sides, nail the back to them. Nail on the front. Fit the bottom, and nail. Bevel one edge of the top 3/16 in.



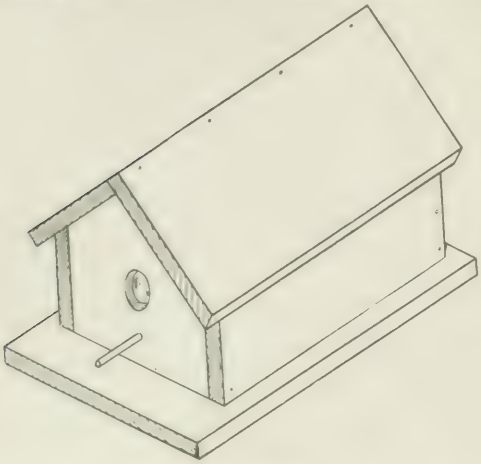
Bore the hole. If a large bit is not available, make a 2-in. circle. Bore with as large a bit as you have and finish with a keyhole-saw and jack-knife. Fit and nail the top.

Bevel both ends of the door 3/16 in. Make the egg hole in the same way as the lamp hole. The position can be changed, if necessary, to line up with the top of the lamp flame. Pad the edge of the egg hole on the front side of the door by tacking a strip of felt or heavy woollen cloth around it. Fit and hinge the door and put on screw-hook and eye to fasten. If the lamp smokes, bore several small holes in the back of the candler, close to the bottom. If you should have a box of suitable size and shape, cut off one corner of each side, place a door on it, and bore the necessary holes. The best results are secured when used in a dark room.

Bird-house:



A board 7 in. wide and 5 ft. 6 in. long will be sufficient to cut the eight pieces required. If the lumber be ordered surfaced on two sides, it will not be necessary to plane to thickness. Set out the parts on the board carefully, allowing sufficient space between each to square up to width and length. Square up the pieces as follows:



One piece ½ in. x 6½ in. x 10 in. for base,
Two pieces ½ in. x 3½ in. x 8 in. for sides,
Two pieces ½ in. x 4½ in. x 6¼ in. for ends,
One piece ½ in. x 4¾ in. x 9½ in. for roof,
One piece ½ in. x 5¼ in. x 9½ in. for roof.

The perforated trefoil at the top is intended for ventilation, but may be omitted if desired, as ventilation is also provided for at the junction of the sides with the roof. If the trefoil is made, the sides may be bevelled to fit the roof, the openings at those points being thus closed. The perch consists of a piece of ¼-in. dowel 2 in. long, glued in. The parts are nailed together with one-inch finishing nails. The bottom may be screwed on so that it may be removed for cleaning, or if desired, the house may be secured to the base by hooks and eyes.

WHAT TO MAKE

Various articles for construction may be grouped as follows:

1. For use in connection with wood-working at school or home:

Bench hooks	Nail boxes	Tool-racks
Footstools	Book-racks	Chiselling boards
Saw-horses	Tool boxes	Coat hangers
Pen trays	Key labels	Pencil boxes

2. For use in connection with primary manual training work at school:

Looms	String winders	Pencil sharpeners
Modelling tools	Paper folders	
Weaving needles	Modelling boards	

3. For use in connection with household science work:

Cutting boards	Moulding boards	Knife-boxes
Stirring paddles	Trays	Key labels
Sleeve boards	Bread-boards	Salt boxes
Match scratchers	Crumb-trays	
Scoops	Shelves	

4. For use in connection with agriculture at school and at home:

(*a*) For garden work:

Hotbeds	Measuring crates	Bird-houses
Plant labels	Vine screens	
Forcing-boxes	Planting sticks	

(*b*) For poultry work:

Trap nests	Water fountains	Brooder boxes
Egg testers	Feed hoppers	
Chicken coops	Egg boxes	

(*c*) For general use:

Saw-horses	Step-ladders	Wagon jacks
Hatchet handles	Eveners	Single trees
Flytraps	Snow-shovels	Sleds
Seed testers	Sewing horses	Corn curers
Hammer handles	Milk stools	Rabbit traps

SUGGESTIONS TO TEACHERS

Previous to teaching the making of any object it is essential that the teacher himself should have made it. This is indispensable to a successful lesson. A careful study should then be made of the different steps, and their order determined. By making the model the teacher will discover which steps in the process are liable to lead to difficulty, and, therefore, need special emphasis in teaching. In many cases two models should be made—one the exact size, from which the pupils can take measurements when this method is used, and the other, two, three, or four times the size. The latter can be used for demonstration purposes. The description of each problem in this Manual is intended to be helpful and suggestive; but the teacher must make that description his own before the problem can be taught effectively. The individuality of the teacher determines to a large extent the method of presentation.

The best use should be made of the limited time available. Owing to the amount of material and equipment required, much time may be wasted in its distribution and collection. This can be avoided by careful organization and by systematizing details. Cupboards in which the material and equipment may be kept, each in its own place and readily accessible, will prove of great assistance. All such materials should be distributed, collected, and cared for almost entirely by the pupils. Some system which is speedy and quiet, and which, once adopted, can be carried out without very close supervision, should be used. Two minutes should be ample time in which to distribute material to a class of forty pupils.

Certain pupils should be appointed as monitors or helpers who will assist in preparing material. Every day before school opens these will see that the necessary material is ready. When required, one pupil may distribute cardboard, another scissors, and so on.

Such materials as paper, cardboard, envelopes containing sewing or weaving materials, may be distributed by monitors to pupils in the front or end rows of desks; each front or end pupil receiving sufficient for all the pupils in his row. At the given word or signal, the first pupil takes what he requires and passes the rest back or along.

In the case of clay work, the helpers should see that a sufficient quantity of material is ready before school opens or during recess, so that the clay can be immediately distributed in lumps as required. Another good way of dealing with clay is to have each pupil provide himself with a small glass sealer (a pint jelly jar). In this he can keep a supply of clay ready for instant use. The jars may be kept on a shelf, or each pupil may keep his in his desk.

Cut pictures, materials for weaving, sewing, etc., should be kept in envelopes—enough material in each envelope for a pupil.

Where paste is used, the cleanest and most economical plan is to have each pupil provide himself with a shallow, wide-necked bottle, which can be kept in the desk and refilled when necessary. Suitable bottles with a screw metal stopper can be bought cheaply. If each pupil cannot get one, a number of bottles should be provided for general use and distributed as required. Pieces of stiff cardboard, about ¾ in. wide and 1½ in. long make good paste spreaders. The method of distributing paste in shallow pans or on pieces of cardboard is the next best plan, but it is generally wasteful and dirty.

Everything should be put away in good order; this saves time next day.

The instructions given should not be confined to "model making". It is always profitable to spend two or three minutes in showing the relationship of the work being done to the problems which preceded it, and also to work done outside the school. Geometric principles and terms should be taught as the necessity for them arises. In teaching the drawing required for any particular model, the outline common to the entire figure should be drawn, before spacing and drawing details. Whatever shape or form a figure may have, there is always some geometric motive and some regular outline defining and inclosing it. Where the inner details of a figure depend on the motives of outlines of a circle, a square, or a rectangle, these latter must be drawn first. Proceed from without inward.

Reduced to a principle this may be stated thus: Draw the outline and then divide into definite spaces to obtain proportion and symmetry. Allow only a limited use of the eraser.

In planning the work, the desires and needs of the pupils should be considered rather than those particular forms of work in which the teacher may be most interested.

In teaching the making of any particular object the following method is suggested:

1. An investigation of the model by teacher and pupil, for the purpose of discovering its development and of ascertaining the shape and dimensions of the material required.

2. The construction of the development of the object from measurements taken from the model, and the completion of the object by folding, cutting, and pasting, etc.

3. The giving of exercises based on the work done, to enable the pupils to apply and extend their knowledge and to encourage initiative. The exercises should be regarded as typical.

4. Alternate this method by allowing the pupils to develop under guidance a model for a particular purpose. (See the "Illustrative Lesson on the Pen Tray", page 87.)

Avoid too many directions. Generally, it is not wise to tell the pupil what he can discover for himself in *reasonable* time. A good model is often the result of too much instruction, and, if the production of the model were the object to be aimed at, this would be well: but the production of the model should always be subsidiary to the thought processes involved. An inferior model may often mean more to the individual than the one which is technically perfect.

Aim from the first for a high standard of work. Give exercises which are within the ability of the pupils and have them done well. It is, however, not wise to insist on an unreasonable degree of accuracy from young pupils. Giving very difficult exercises and then being satisfied with a low standard of work has a decidedly injurious effect. At the same time the exercise should not be so simple that it can be performed without distinct mental effort on the part of the pupil.

Always encourage the suggestion of other methods of construction and decoration and the devising of ways and means. Even if these ways are not the best, it is sometimes well to let the pupils try them and then compare them with others.

Throughout the whole of the work, neatness, tidiness, and accuracy should be cultivated. The pupils should not be allowed to litter the floor with scraps of

paper. Every pupil should make or be provided with a large roomy envelope inscribed with his name, to contain pictures, cuttings, and scraps of cardboard that will likely be of service in future work. Economy of material should always be insisted upon.

When it is necessary to give directions, they should be brief and clear. No more words should be used than are necessary to give the definite instruction required. Vary the expression of these directions, so as to avoid monotonous repetition of the same forms. The black-board should be freely used, and the lines drawn should always have the same meaning. For example, a dotted line should always represent a fold, and not a fold at one time and a construction line at another.

A valuable method for Forms I and II especially, is to go through every process and make the complete object before the class. At one time this may be done before the pupils begin work, and, during the process, the pupils are expected to observe exactly what is done by the teacher, so that when they begin work they will be able to construct the object entirely from their own knowledge. At another time the teacher may make the object, step by step, the pupils constructing their objects as he proceeds. Very rarely a lesson may be given entirely by directions.

After the pupils have had a certain amount of training, the plan should occasionally be adopted of placing a drawing on the black-board and having the model made entirely from it.

In a small class the pupils may make a model from one previously made by the teacher or an older pupil. Much of the work will of necessity be done during seat-work periods.

A successful lesson in this work is marked by certain characteristics—on the part of the teacher, by a thorough acquaintance with the subject gained through previous preparation, clear and concise direction, and adoption of correct technical methods; and on the part of the pupil, by strict attention to the directions given, concentration, earnestness, a spirit of cheerfulness and enjoyment, and by the production of the best work of which he is capable at that stage.

In arousing and stimulating interest in this work among parents and pupils, exhibitions serve a useful purpose. If no better place be available these may be held in the class-room. It is advisable not to crowd the exhibits. Various exhibits—hand-work, drawing, art, garden products, collections of minerals and fabrics, or other educational material may well be made periodically.

FORM V

COURSE OF STUDY

Junior Grade

Drawing.—Review of the Courses of Forms III and IV. Simple plans and elevations. Correct use of drawing-board, T-square, triangles, and compasses. Construction of the common geometrical figures. Simple lettering and figuring. Working drawings of objects made, either full size or to scale.

Wood-work.—Review of the Public School Course. Growth, structure, and identification of the woods used in the manufactures of the locality. Warping, twisting, checking—how caused and counteracted. Making of simple objects according to drawings previously prepared. Proper use of nails, screws, and glue. Use of simple joints in articles made: for example, end half lap, centre half lap, mitre, housing. Use and mechanical construction of common wood-working tools as exemplified in the making of a series of useful objects. Construction of simple school apparatus.

Senior Grade

Drawing.—Elementary orthographic and isometric projection. Simple sections. More advanced geometrical drawing. Freehand dimensioned sketches. Inking, tracing, lettering, and blue-printing. Working drawings of objects made.

Wood-work.—Growth, structure, and identification of the woods used in the locality. Tool sharpening. Common joints used in various kinds of wood-work —scarfing, simple dovetail, mortise and tenon, tongue and grooved joint—their use in making objects such as boxes, drawers, tables, book-cases, etc. Fastenings with dowels, pins, cleats, wedges, etc. Calculations, from drawings and specifications, of lumber required for articles made, and the cost. At least every alternate piece of work must be kept for inspection.

Various methods of finishing, as staining, fuming, filling, shellacing, oiling.

Wood Turning.—Explanation of the lathe, its action, speed, parts, care, and use. The gouge; correct position, turning rough cylinder. The skew chisel; reason for grinding both sides and at an angle. Concave surfaces with skew chisel: review exercises. Irregular curves and spindle work. V-grooves, beads, and hollows. The introduction of hard wood and sand-paper; exercises in turning handles. Face plate turning, chuck work, boxes with covers, powder box, napkin-rings, goblet, etc. Every piece of work must be kept for inspection.

Forging.—The forge, the fire, the heat, the height of anvil, and its position.

The ordinary tools: how to use and care for them. Hammer, sledge, chisel, fuller, and swage. Drawing, forming, upsetting, bending, and twisting iron, stamping and forge-blacking the finished piece; exercises of simple design and construction, as gate hook, turning eye and hook. Scarfing, bending, and welding. Every piece of work must be kept for inspection.

Machine-shop Practice.—Simple ornamental work in brass, copper, and iron. The making of simple objects, such as watch fobs, paper knives, blotter corners, trays, bowls, etc.

Simple clipping and filing. Use of measuring and marking tools.

An elementary study of the engine lathe: its parts, adjustment, and working. Proper tool angles and cutting speeds and feeds. The exercises taken should, where possible, involve completed objects. All work must be kept for inspection.

BOOKS FOR REFERENCE

WEAVING AND BASKETRY

Hand Loom Weaving. Todd. The Geo. M. Hendry Co., Ltd., Toronto

Well illustrated, clear and concise directions for weaving many simple articles. Contains a useful list of helpful books and magazine articles.

Practical and Artistic Basketry. Tinsley. McClelland & Stewart, Toronto

Contains an outline of a course in basketry for the public schools. One of the clearest books on the subject, containing much not found elsewhere.

Baskets and How to Make Them. White. McClelland & Stewart, Toronto

More Baskets and How to Make Them. White. McClelland & Stewart, Toronto

Two standard works by a recognized authority. Materials fully described and full instructions given. Well illustrated. The first-named book is the better one.

Raffia and Reed work. Knapp. The Geo. M. Hendry Co., Ltd., Toronto

Outlines a course from the kindergarten, through the public school grades, in paper weaving, cardboard, raffia, etc. Well illustrated. All weaves clearly shown.

Primary Hand Work. Seegmiller. Educational Book Co., Ltd., Toronto

Helpful and suggestive for the primary teacher. Deals largely with paper weaving for children six years of age and upwards. Forty diagrams.

Varied Occupations in Weaving. Walker. The Macmillan Company of Canada, Limited, Toronto

One hundred and seventy-eight illustrations. Treats of various kinds of weaving in paper, ribbon, string, straw, and cane.

PAPER AND CARDBOARD

Paper Sloyd for Primary Grades. Rich. Ginn & Co., New York

Contains 47 drawings of cardboard models, divided into three years, and 14 supplementary models with full directions for making.

Story Telling with Scissors. The Geo. M. Hendry Co., Ltd., Toronto

An excellent little manual for primary work. Sixty-two plates, black on white, with appropriate verses.

Manual Arts with Scissors. Moran. The Geo. M. Hendry Co., Ltd., Toronto

Contains illustrative free cutting exercises for each month. Good for reference.

First Years in Handicraft. Kenyon. Baker & Taylor Co., New York

A series of 50 simple articles in paper and thin cardboard, suitable for children from seven to eleven years of age.

Plan Book with Scissors and Paste. McClelland & Stewart, Toronto

A series of 50 drawings, white on black, as suggestions for paper cutting, with an introductory chapter of directions.

Paper Modelling. Swannell. George Philip & Son, Ltd., London

Very useful and suggestive, deals with common objects as found in every home. Something agreeably different from the ordinary exercises.

Paper and Cardboard Construction. Buxton and Curran. McClelland & Stewart, Toronto

Covers book, box, card, and envelope problems for the first four grades and suggestions for equipment, supplies, and methods.

Paper Cutting and Modelling—2 books. Pring. Pitman & Sons, London, Eng.

Paper Cutting and Folding for Seniors. Pring. Pitman & Sons, London, Eng.

An exceedingly useful book.

Book Binding and Care of Books. Cockerell. D. Appleton & Co., New York

A well written and fully illustrated book on the technical processes of book-binding by a famous English binder.

CLAY

Modelling for the Standards. The Geo. M. Hendry Co., Ltd., Toronto

Plastic Methods for Plastic Minds. The Geo. M. Hendry Co., Ltd., Toronto.

Easy Modelling for Infants. The Geo. M. Hendry Co., Ltd., Toronto

How to Use Plasticine. The Geo. M. Hendry Co., Ltd., Toronto

Above books well illustrated. Most of the objects given could be modelled in clay, as well as plasticine.

Clay Modelling for Infants. F. H. Brown, A.R.C.A. The Copp Clark Co., Limited, Toronto

Clay Modelling for Little Ones. Pearce. George Philip & Son, Ltd., London

A useful manual, based largely on natural forms; good on method; well illustrated.

Clay Work. Lester. McClelland & Stewart, Toronto

Deals with plant life, human figure, story illustration, simple architectural ornament, titles, and elementary pottery.

Modelling in Public Schools. Sargent. J. L. Hammett Co., 250 Devonshire Street, Boston

A Manual of Clay Modelling. Unwin. Longmans, Green & Co., London

Sixty illustrations of natural and common objects. Very helpful.

Clay Modelling. Holland. Ginn & Co., New York

Gives a progressive course of models for the grades. Contains a useful introductory chapter and 18 plates.

VARIOUS MATERIALS

Constructive Work. Worst. A. W. Mumford, 157 W. Adams Street, Chicago

Manual training related to number work, history, literature, and nature study. A chapter on vegetable dyes. A very useful book.

Hand Work for Kindergarten and Primary Grades. Hoxie. The Geo. M. Hendry Co., Ltd., Toronto

A useful book, dealing with wood-work for primary grades, raffia weaving, etc., and the making of blue prints from leaves.

What and How. Palen and Henderson. The Geo. M. Hendry Co., Ltd., Toronto

Suggested "Time Table" given. Illustrations excellent. Exercises for special days. A very good book.

Seat Work and Industrial Occupations. Gilman and Williams. The Macmillan Company of Canada, Ltd., Toronto

One of the best of the low-priced books.

Educational Hand Work. T. B. Kidner. The Educational Book Co., Ltd., Toronto

A chapter on elementary descriptive geometry. A good book.

School Drawing—A Real Correlation. Daniels. The Geo. M. Hendry Co., Ltd., Toronto

Correlates drawing, sand and clay modelling, paper work, etc., with history, literature, geography, etc. Should be in every school.

The Place of Industries in Elementary Education. Dopp. University of Chicago Press, Chicago

Offers much toward solving the problems of hand-work in the grades, both lower and higher. Should be studied by every teacher.

How to Make and How to Mend. The Macmillan Company of Canada, Ltd., Toronto

Arranged in dictionary form. Should be in every school and home.

Construction and Flying of Kites. Miller. McClelland & Stewart, Toronto

An exceedingly useful and interesting pamphlet for boys.

Correlated Hand-Work. Trybom and Heller. The Geo. M. Hendry Co., Ltd., Toronto

Correlates work in clay, paper, cardboard, etc., with the ordinary work of the schoolroom.

Occupations for Little Fingers. Sage and Cooley. McClelland & Stewart, Toronto

Includes suggestions on the use of cord, string, raffia, and clay, sewing, paper cutting, and folding, weaving, crocheting, knitting, and the furnishing of a doll's house.

Industrial Work for Public Schools. Holton and Rollins. Rand-McNally & Co., Chicago

Eighty half-tones. A course of four years' work in various materials.

The American Boy's Handy Book. Baird. Charles Scribner's Sons, New York

Three hundred and twenty illustrations. One of the best boy's books on "What to do and How to do it".

The Service of the Hand in the School. Bone. Longmans', Green & Co., New York

An actual record of school practice. A most useful book.

Handicraft in the School. 5 Vols. Various authors. Gresham Publishing Co., London, Eng.

The Book of School Handiwork. Ed. Holman. Caxton Publishing Co., London, Eng.

The above two works are very comprehensive and deal with almost all possible forms of school handwork.

Manual Training Play Problems. Marten. The Macmillan Co. of Canada, Ltd., Toronto

Constructive work for boys and girls, based on the play interest. A very attractive and useful book.

WOODWORK

Hand Work in Wood. Noyes. McClelland & Stewart, Toronto

Covers logging, saw-milling, seasoning, measuring, hand tools, fastenings, equipment, joints, and furnishing. Three hundred and four illustrations. An excellent book.

Woodwork for Beginners. Wheeler. G. P. Putnam's Sons, New York

A very suggestive book. Deals with a variety of subjects, all interesting to boys. Thoroughly recommended.

Woodwork on Scientific Lines. Bailey and Pollit. McClelland & Stewart, Toronto

Contains a number of educational exercises, many of them being pieces of apparatus for elementary science. A very useful book.

The New Education, Manual Training Woodwork. Wake. Chapman & Hall, Ltd., London, Eng.

Gives a three years' course in woodwork for public schools. Good on method, leading to design and invention. Well illustrated.

Elementary Woodworking. Foster. Ginn & Co., New York

Deals with tools and their uses. Second half of the book deals with timber and trees. One hundred and thirty-six illustrations.

Woodworking in the Common School. Hinckley. The Geo. M. Hendry Co., Ltd., Toronto

Deals with woodwork, in the class-room, by the grade teacher. Two hundred and seventy-five drawings.

Coping-saw Work. Johnson. McClelland & Stewart, Toronto

A useful book of suggestions for "Out of School" work.

Elementary Woodwork. Selden. Rand-McNally & Co., Chicago

Two hundred and six pages. Well illustrated. A series of 42 exercises. Tool operations. Illustrated from photographs.

Toys and Toy Making. G. F. Johnson. Longmans, Green & Co., London, Eng.

Manual Training Toys. Manual Arts Press, Peoria, Illinois

INDEX

PAGE

Preface 3

Introduction 5

Public School Course of Study (Details) 9

Materials and Equipment 12
- Plasticine and Clay 12
  - Equipment Required 12
  - Storing Clay 13
  - Mixing Clay Flour 13
  - To Prepare Clay from a Natural Clay Bed 13
  - To Keep Clay in Good Condition 13
  - Modelling Mixtures for Permanent Objects 14
  - Hints on Working Clay 14
  - Armatures 14
- Sand Table 15
  - To Wash Sand 15
- Paper Work 15
  - Engine-coloured Paper 15
  - Tinted Drawing, Construction, and Mounting Paper 15
  - Heavy Folding Paper 15
  - Pastes 16
  - Other Materials Used 16
  - Cardboard Construction 16
- Thin Wood 17
- Printing Frame, The 18
- Raffia and Other Materials 19
  - Dyeing 19
- Hectograph, The 21

Seat Work for Rural Schools 22
- Numbers 23
- Counting Exercises 23
- Miscellaneous 24
- Reading and Language Study 25
- Nature Study and Agriculture 25
- Geography 25

Form I. 26
- Pupil's First Day in School, The 26
- Modelling in Plasticine 32
  - Lesson in Bead Making 32
  - Rolling Plasticine 33
  - Hollowing 33
  - Objects from the Ball 35
  - Designs 35
  - Drawing on Plasticine 35

FORM I—*Con.* PAGE
Modelling in Clay 39
Illustrative Lesson—Apple 39
Sand Table 41
Paper Cutting (Six Steps) 43
Cutting Balanced Forms 47
Mounting 47
Class Scrap-books 47
Paper Folding 48
Objects Based on the Square 49
Illustrative Lesson—Checkerboard 49
Weaving 54
How to Cut Warp and Weft 55
Work in Raffia 55
Winding or Wrapping 57
Mats 57
Braiding 57
Simple Looms 61
How to Plan Simple Weaves 63
Raffia and Canvas 63

FORM II. 65
Plasticine and Clay Modelling 65
General Directions for Modelling 65
Paper Folding and Cutting 70
Free Cutting 70
Folding for Geometrical Units 71
Objects Made from Paper 74
Development of a Lesson on the Windmill 74
Cardboard Construction 80
Construction of the Square 80
Illustrative Lesson on a Pen Tray 87
Pictures 91
Mounting Pictures 91

FORM III. 92
Clay Modelling 92
Pottery 92
Leaves and Shells 96
Geographical Formations 96
Relief Maps 97
Paper Cutting 99
Cardboard Construction 101
Construction of the Triangle 101
Mechanical Drawing 109
Geometrical Problems 109
Scale Drawing 115
Full Scale 115
Half Scale 116
Quarter Scale 116
Reading of a Drawing 117
Use of Drawing-boards, T-Squares, and Set-Squares 118
Plans and Elevations 120
Method of Teaching Simple Plan and Elevation 120
Lettering 123

FORM III—*Con.* PAGE
Work in Thin Wood 124
Strip Wood-work 130
Suggested Models 131

FORM IV. 144
Clay 144
Modelling from Nature 144
Modelling from Casts 144
Design 144
Cardboard Construction 145
Lesson on the Cube 145
Simple Repairs to Damaged Books 154
Mechanical Drawing 155
Geometrical Problems 155
Metric Scale 157
Protractor 157
Plans and Elevations 158
Work in Thin Wood 159
Coping-saw Work 162
Suggestions for Colouring Birds 164

RURAL SCHOOL BENCH WORK 169
Accommodations 169
Benches 169
Tools Required 171
General Tools 171
Storing Tools 171
Description of Tools 171
Squaring up Stock 182
Notes on Timber 188
Suggested Projects 191
What to Make 200

SUGGESTIONS TO TEACHERS 202

FORM V. 205
Course of Study—Junior Grade, Senior Grade 205
BOOKS FOR REFERENCE 206

Picture cutting.
1st four folds.
Describing from Square.
F.C. fruits
flowers
letters
stones
Describing rhombus &c.
original exercise.

1. Use your own patterns only.
2. In sawing make use of the saw tables.
3. See that the teeth of the coping saw blade point towards the handle so that the down stroke is the cutting stroke.
4. Keep saw absolutely vertical. (this is important).
5. Turn the wood to meet the saw.
6. Do not feed saw too quickly or you will get a rough cut.

Rules.

1. Pick up all waste wood and put it in the wood box.
2. Be sure that all the tools are replaced in proper places not more than one plane, chisel, saw, tri-square etc. on one bench.
3. If you drop anything other than shavings or sawdust pick them up.
4. Clean off the benches.
5. Pieces of wood and paper must not be scattered on the floor.
6. Do not scatter nails on the benches put them in the box provided for nails.
7. Any student who cannot abide by these rules keep out of the work-room.

Africa: Relief map

Polyhemus picture story
maf.
wooden basket